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AUTHOR'S EDITION

ANNUAL REPORT ON EXPERIMENTAL FARMS FOR THE YEAR 1899

CANADA

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM

REPORT OF THE ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.)

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GOVERNMENT PRINTING BUREAU

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DR. WM. SAUNDERS,
Director of Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to hand you herewith a report on some of the more important subjects which have been brought officially under my notice during the past season. There is, as in previous years, and as must always be the case, a vast amount of material accumulating in the Division which cannot be mentioned in the annual report, but which is frequently of use in answering correspondents and explaining to visitors the work of the Division.

Since the appointment of Mr. Arthur Gibson as a new assistant, in April last, many specimens have been secured for permanent exhibition in the museum. Exhibition cases in which the commonest injurious and beneficial insects can be shown have been a great desideratum here, a want which is now being filled as quickly as possible. Several new cases have been secured during the summer, but when the accumulated material has been arranged even these will not be sufficient to display all the specimens, and other cases are now being made.

The experiments in growing grasses and fodder plants have been continued and, as in the past, have proved of great interest to all visiting farmers. The Awnless or Smooth Brome Grass, which since 1887 I have taken great pains to introduce and distribute through the north-western provinces, still continues to give the greatest satisfaction to all who have tried it. It is a heavy producer of excellent fodder and hay, is succulent, appears early in spring and lasts late into the autumn. It is a free-grower, thriving both on light sandy soils and in rich low bottoms. Owing to its vigour and free growth, it has been found useful for holding alluvial flats liable to flooding and also as a binder of drifting sand. Some two or three years ago a sample of seed was sent to Mr. R. J. Bouteiller, Superintendent of Sable Island, off the coast of Nova Scotia, to whom it has given much satisfaction. He reported on it last year as follows:—‘The Awnless Brome Grass seed was planted about the 20th May, and I mowed a heavy crop in August, much of it headed out. I am much pleased with it and believe it will be a success.’ During the past summer Major F. Gourdeau, the Deputy Minister of Marine and Fisheries wrote as follows:—‘Referring to the Awnless Brome Grass, of which you supplied seed to Sable Island, I beg to inform you that a letter has been received from the Superintendent of the island, in which he states that the plot of this grass is ahead of anything else, and measured on the 27th June between 3 or 4 feet and more in height, while timothy in just as good ground was a little over half of that.’

Awnless Brome Grass has also given tolerable satisfaction upon alkali patches in the west, succeeding better than all other varieties tried.

Subjects requiring special attention since I last reported were the following :—

THE HESSIAN FLY.—A serious outbreak in Manitoba.

THE ROCKY MOUNTAIN LOCUST.—This insect again appeared in some numbers in southern Manitoba, but was not the cause of an appreciable diminution in the crops. The exceptionally wet and late season in Manitoba during the past summer was unfavourable for its early development and spread, and the farmers, having been stirred up to an appreciation of the danger of allowing this insect to remain undisturbed, ploughed down the greater part of the stubbles this autumn, thus burying the eggs too deeply for the young to emerge next spring.

THE DESTRUCTIVE PEA APHIS.—One of the most notable outbreaks of the year was by a plant-louse which has been given the above name but which before this year was unknown.

ROOT MAGGOTS.—Some experiments against these destructive enemies of the gardener were tried last season with many different substances, but so far without very satisfactory results. Mixtures containing some form of carbolic acid were most useful.

THE DIAMOND-BACK MOTH (*Plutella cruciferarum*, Zell.).—Late in the autumn there was in eastern Ontario a widespread and severe attack upon cabbage of various kinds, rape, and turnips, by this insect, which has been well known for many years as an occasional pest of these plants, and was fully treated of, and figured, in my report for 1890. In *Farm Insects*, by John Curtis, 1860, the same insect is described and well figured as the Turnip Diamond-back Moth.

THE ASPARAGUS BEETLES.—Two new enemies of the gardener have appeared in Canada for the first time this year, the two Asparagus Beetles. These are treated of at some length later on.



Fig. 1.—The Forest Tent Caterpillar.

TENT CATERPILLARS.—Orchard and shade trees were again this year seriously injured throughout the greater part of Ontario and Quebec by the caterpillars of the two common species of Tent Caterpillars. Nothing new can be added as to remedies; these consist of the collection of eggs in winter, the destruction of the nests and clusters of young caterpillars in spring, and last, but most important, the spraying of trees with poisonous mixtures as soon as possible after the hatching of the eggs. The last operation, when performed carefully, is a never-failing remedy.

BARK-LICE.—The San José Scale and several other allied species of scale-insects have naturally been the subject of much correspondence. Thorough experiments are now being carried out by specialists in all parts of North America with the hope of discovering a practical remedy. Several materials have given good results which with ordinary insects might be considered all-sufficient remedies, but with the San José Scale it seems inadvisable to recommend under the existing laws which have been passed by the Federal Government and those of Ontario and British Columbia that fruit growers themselves, should be allowed to treat their trees with any of the materials which, up to the present, have been claimed to be 'sure remedies,' such as pure kerosene, the same mechanically mixed with water, and crude petroleum.

THE APRICOT SCALE (*Lecanium armeniacum*, Craw).—Another scale insect from California, which in some way has been introduced into the Eastern States, and is spreading there to some extent, has been found in two or three orchards at Sherbrooke, Que.

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THE RASPBERRY WEB-WORM.—A local but interesting attack by a new enemy to cultivated raspberries was reported from St. John, N.B., last year, and has been worked up during the past season.

THE CRANBERRY LOOPER (*Caterva catenaria*, Cram.).—A new attack of some severity upon strawberries was by the common 'Cranberry Worm,' which was reported by Mr. George Bonner, of Point Aconi, Cape Breton, N.S.

THE PEA MOTH (*Semasia nigricana*, Steph.) is still much complained of, particularly in the Maritime Provinces, as shown by the following letter:—

'CLIFTON (King's Co.), N.B., December 19.—I have not made any recorded observations, but think this insect was not quite so destructive last season as usual. It has, however, come to be such a matter of course with us, that we take its ravages quite philosophically and pick the caterpillars out of our peas for the table; when too bad, we throw the whole mess to the pigs or cows. This insect has been injurious here for a period beyond my recollection, some 50 years.'—J. W. WETMORE.

THE CARROT RUST-FLY (*Psila rosæ*, Fab.) continues to be a troublesome pest of carrots in the province of New Brunswick. Mr. J. E. Wetmore, of Clifton, N.B., writes:—'Of late years we have about abandoned the culture of the tender varieties on account of its depredations. It does not trouble the hardier varieties here apparently, for we can get full crops of the white carrots when the orange ones are a complete failure in the same field.'

In Prince Edward Island, Father Burke reports widespread injury by plant-lice upon carrots.

THE SPRUCE GALL-LOUSE (*Chermes abietis*, Linn.).—A cause of considerable inquiry and anxiety among those interested in the manufacture of paper during the past year or two has been the Spruce Gall-louse. This insect is prevalent through a large part of Ontario, attacking the Black and Norway Spruces. In the Rocky Mountains, galls probably made by a different species were noticed in abundance on White Spruces at Banff, Alberta, and, on Vancouver Island, trees of the Menzies Spruce (*Picea sitchensis*, Carr.) in certain places in the forests, were much disfigured by another species of Chermes, probably *C. sibirica*, Cholodk., which forms large galls, sometimes two inches in length by nearly one in diameter. These were not found at all on the Douglas Spruce.

THE BLACK VIOLET APHIS.—An infestation of greenhouses not previously complained of in Canada by the above insect occurred in Toronto, and is treated of later in this report.

THE GREENHOUSE LEAF-TYER is also a new pest treated of hereafter.

THE CARPET BEETLE OR 'BUFFALO MOTH' (*Anthrenus scrophulariæ*, Linn.).—This troublesome pest of the housekeeper seems to be spreading and becoming more destructive year by year. During last spring a few specimens were taken out of doors at Ottawa on the flowers of Currants and Spiræas. Beetles were also sent from Bewdley (Northumberland Co., Ont.) which had been found by Mr. T. W. Ramm, in the folds of a cloth left hanging in an apple tree during winter.

Correspondence.—From November 30, 1898, to November 30, 1899, the number of letters received by the Division was 2,495, and of letters sent 2,320.

Meetings attended.—Meetings of farmers, dairymen and fruit growers have been attended at the following places:—January 10 and 11, at Kingston; 27, at St. Catharines; February 3, at Hemmingford, Que.; 10, at North Gower, Ont.; March 10, at Merivale, Ont.,

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17, at Montreal ; April 3, at Napanee, Ont. ; 4, Brampton ; 5, Oakville ; 6, Hamilton ; 7 St. Catharines ; and three series of meetings in Manitoba, the North-west Territories and British Columbia are reported on at the end of this report.

Acknowledgments.—As in previous years, I am under great obligations to many correspondents, to practical farmers, who have much aided the work of the Division by making observations and sending in prompt reports on the occurrence of injurious insects and weeds, and to scientific experts in Canada and abroad. I must particularly mention in this connection Prof. John Macoun, of Ottawa, for assistance on many occasions, and also Dr. L. O. Howard, United States Entomologist, of Washington, D.C., and Dr. J. B. Smith, of New Brunswick, N.J., for frequent assistance in the identification of insects and for the use of electrotypes and magic lantern slides.

In conclusion I have much pleasure in expressing my appreciation of the enlarged opportunities for doing good work in the Division entrusted to my care, which have been granted me during the past year.

Mr. Arthur Gibson, of Toronto, was appointed as an extra assistant on April 1 last, and has shown great assiduity and care in all matters entrusted to him. Mr. J. A. Guignard, B.A., the Assistant Entomologist and Botanist, continues to help me in all branches of the work of the Division, and as heretofore has done much to bring the Division of Entomology and Botany to such degree of efficiency as it has attained.

I have the honour to be, sir,

Your obedient servant,

JAMES FLETCHER,

Entomologist and Botanist.

CEREAL CROPS.

Complaints of injury to the wheat crop by insects during 1899 were few, with the exception of a new and severe outbreak of the Hessian Fly in Manitoba, a rather serious occurrence of the same insect in Western Ontario, and a slight one in Prince Edward Island.

In the November *Crop Report* (Ontario Bureau of Industries) it is stated:—‘There has been a notable absence of insect pests. There are few complaints of insect pests except that Hessian Fly, Jointworm and Wireworm have done some damage.’ ‘Alberton, P.E.I., October 31.—Seldom has Prince Edward Island garnered a more satisfactory all round harvest than this year. Hay is bursting the mows, the granaries are filled with golden grain, and although in some sections potatoes are not an average crop, on the whole, we rejoice in an excellent yield of roots.’—REV. A. E. BURKE.

‘Pleasant Grove, P.E.I.—The wheat crop on the whole is a good one; some fields were damaged by what we call ‘black neck,’ said by some to be the rust. Attacks by the Hessian Fly were not common, a few plants being injured, but we have had a considerable quantity of Wheat Midge on the Island this year.’—E. WYATT.

Barley was slightly injured by Hessian Fly in Manitoba, and oats and corn in Ontario to some extent by grasshoppers. The two most serious outbreaks of the season upon cereals were by Hessian Fly in Manitoba and in Western Ontario, and by a new enemy of the pea, the Destructive Pea Aphis, which did great damage to field peas from the Maritime Provinces to Western Ontario in Canada, and extended right down to the Southern States in the Union. That old enemy, the Pea Weevil, was also more than usually destructive and abundant during the season of 1899.

THE HESSIAN FLY

(*Cecidomyia destructor*, Say).



Fig. 2.—The Hessian Fly—enlarged and natural size.

Complaints of injury by the Hessian Fly during the past season were numerous to fall wheat in Ontario and to spring wheat in Manitoba. Wheat was injured in many parts of Manitoba, but chiefly in the Red River valley. The most western occurrence reported to me (with specimens) was from Moose Jaw, in the North-west Territories. At the request of some of my correspondents for public advice as to the best means of preventing future loss, articles were prepared for publication in the *Farmer's Advocate* (September 15) and the *North-west Farmer* (September 20), both excellent agricultural journals, widely circulated and read by farmers, in which the chief points in the life history of the insect were given and suggestions made as to the best known remedies.

The following extracts from some of the large correspondence on the matter will show the extent and nature of the outbreak. The first reports and specimens from Manitoba were received from Mr. Hugh McKellar, Chief Clerk of the Provincial Department of Agriculture.

‘Delmer (Norfolk Co.), Ont., August 8.—In view of the immense damage done by the Hessian Fly to the wheat crop in this and in many other localities throughout the

province, farmers are very much interested in the matter and would like to know something of the habits of this insect—whether it is likely to assert itself in next year's crop, whether the discontinuance of wheat growing for a season would be necessary to exterminate it, or whether such omission would be of any value in eliminating the pest, &c., &c. Any information you could give us would be very gratefully received, especially at this juncture—the eve of another seeding.'

'Delmer, September 13.—In South Oxford the fly was very injurious, destroying fully one-half of the fall wheat remaining, after an unusually severe 'winter killing'—there was scarcely a wheat field that was not injured more or less; the earlier sown suffered most. In North Oxford damage was much less, in West Brant, also much less, ditto in West Norfolk, in East Elgin middling severe, quite severe in East Middlesex; and again, in North and West Middlesex not so severe.'—CHAS. BRADBURN.

'Winnipeg Man., August 26.—Herewith I am sending you specimens of an insect that has done considerable damage on the farm of Mr. James Little, Stonewall. The specimens were forwarded by Mr. Ira Stratton, of Stonewall, who says that about one-quarter of Mr. Little's wheat has been cut down by these insects. Would you kindly let us have any information at your command regarding this pest, and what measures should be adopted to prevent its recurrence next year?'—HUGH McKELLAR, *Chief Clerk, Dept. Agriculture.*

'Macdonald, Man., August 26.—I notice since starting to cut my wheat that quite a lot of the straw is broken just above the second joint, although the heads seem to be well filled; of course the sap is not altogether stopped as the straw is not broken completely off. I find on examining it that there is a single maggot or worm in a brown shell, between the leaf and stem just above the joint, that has caused the injury. Can you tell me what it is and if it is likely to be worse another year? There is from 1 to 7 or 8 per cent of the straw affected with it.'—HENRY KIRKWOOD.

'Portage la Prairie. Man., August 28.—Inclosed find wheat joints which I have cut from my field. The wheat is bent down just above the joint. I find by opening the straw that there is an insect on the upper side of the joint. The grain in the head appears to be all right, but the straw and head are not as large as the balance that is standing. My heavy wheat does not appear to have been affected. Would you kindly let me know through the *Nor-west Farmer* what it is, as I presume there are other fields throughout the province affected the same way?'—CHAS. CUTHBERT.

'Winnipeg, August 29.—At several points throughout the province I have noticed this year in the wheat fields that a greater or less proportion of the straws appear to break about the first joint from the ground, and, where this is very bad, it gives almost the appearance of their having been broken down by hail, except that most of the straws seem to lean in one direction as though they had gone down under pressure of high winds from one quarter. I am told by some parties that a little worm about $\frac{1}{4}$ of an inch long is found in the straw, at the first joint. The appearance of the head is entirely different from what we call "dead heads" as the grain is maturing in the heads, some of them still being comparatively green, although I think in every case the grain will be shrivelled, and the heads seem to be shorter and smaller than the average heads in the field. I saw two fields of this out at Melita a little while ago, and yesterday at Otterburn saw a great deal of it, and I understand from the farmers at Emerson, that it is very prevalent throughout that district. I was also speaking to a man from Plum Coulee, who told me he had to set his binder much lower than usual in order to avoid cutting off the heads that were broken down, and I am inclined to think that this trouble, whatever it is, is very prevalent throughout southern Manitoba.'

'Winnipeg, Oct. 11.—I fancy the damage done by the Hessian Fly has been pretty serious in some localities, but, as people were not acquainted with the insect or were not looking for it, not many noticed it; perhaps, too, they attributed the shortage to a wrong cause. I understand that its attacks were very bad in the Stonewall, Carman and Niverville districts.'—G. H. GREIG, of *The Farmer's Advocate.*

'Winnipeg, Oct. 3.—In response to your request for information on the Hessian Fly in this province, by Mr. McKellar's instructions, I made an excursion to Stonewall on Friday and Saturday last. There is no doubt whatever that the fly is all through

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the wheat-growing country around Stonewall and Balmoral—every farm I inspected had it. I found puparia in every wheat and barley field I entered, and in every stack of unthreshed wheat looked at. I was able to examine the screenings from one threshing place (on the farm of Mr. J. Little) and here there were puparia in abundance. The first place visited was the farm of Mr. J. McEwen, where there was a piece of breaking very bad with the fly. Mr. McEwen estimates the damage at one-third of the crop, and I am sure the estimate is a careful one. The next place visited was Mr. Jas. Little's. It was from this farm that the specimens were sent to you last month. The damage here was quite as great as on the last place, but in this case the land bore a crop of wheat last year. It was on this farm that I examined the screenings from the thresher. Mr. Martin Shepley estimates the damage done to his summer-fallow at one-fourth or perhaps as much as one-third. I have mentioned these three farms because they are the only cases in which I was able to see the farmers and discuss the question with them. As to barley I could secure no estimate of the damage done. No barley had been threshed, and there is not the same interest in the barley crop as in wheat. I did not find the puparia so numerous in barley fields as in wheat fields. The puparia were almost invariably above the second joint, usually singly, though sometimes in twos and threes. I collected a number of specimens of which I send you a few in case you wish to breed the parasites.

'Summer-fallow and breaking suffered quite as badly and as generally as land cropped last year. Fallow and breaking are naturally the earliest sown, as they are soonest in condition for seeding. The weather during seeding was very cold and backward, and continued so up to the 10th June, after which the most perfect conditions for growth prevailed. I may also quote the statement of Mr. J. Little that the wheat which was earliest cut was less broken down than that cut later. In reply to a further question, he said he did not know whether it was less *damaged*, but it was certainly less broken down. Mr. J. McEwen stated that greener portions of a field were less broken down than riper ones. From this I would point out that the amount of damage was estimated generally from the state of the crop before threshing, that green or under-ripe grain does not break off so readily, and that a crop cut a shade green would not show the full amount of damage done.'—MELVIN BARTLETT, *Dept. Agriculture*.

'Buffalo Lake, Moose Jaw, Assa., Aug. 30.—When I wrote you some three or four weeks ago with regard to the wheat pest, I had not observed any indications of it. Since then it has become quite evident. I learn from a neighbour adjoining me that he had it last year. At present there are quite a number of heads through my crop and a very considerable number in my near neighbour's. It seems especially bad on the outside of the field; where he was cutting wheat 2 or 3 days ago, the outside 10 or 15 feet was very materially damaged. It seemed to attack the maturer heads, not troubling the greener grain much.'—G. S. TUXFORD.

'Emerson, Man., Sept. 1.—I am enclosing to you some samples of wheat straws injured by the insect referred to you some days ago by Mr. Geo Greig of the *Farmer's Advocate*, Winnipeg. You will find them located immediately above the joint first from the ground. Kindly examine and let us know the name, and likelihood of recurrence another year, remedy if any, and any information you deem of use. This pest is more or less found all over the province, and is estimated to have done as much damage in some places as to reduce the yield 20 per cent.'—W. W. FRASER.

'Winnipeg, Sept. 1.—We enclose sample of straw from Winkler Station, where it has drawn attention. Is it the Hessian Fly?'—RICHARD WAUGH, *The Nor-West Farmer*.

'Winnipeg, Sept. 1.—Enclosed find a few stems of wheat straw cut at ground and fallen in crop so as to be missed by the binder. In each straw is an insect, the cause of fall. About one in a hundred of the stems was so affected. What is it and how can it be treated?'—

'Holland, Man., October 4.—In every field I have looked (that is in Manitoba), I have found traces of the Hessian Fly. I know of no other insect doing the farmers any injury this season.'—F. D. BLAKELY, of *The Nor-West Farmer*.

'Balmoral, Man.—I am sending you under separate cover an insect in pieces of wheat straw. It is found at the joint nearest the ground. Just above this joint

it eats its way through the stalk and escapes. The straw bends or breaks at this place, leaving the straw as if fowls had pulled it down. One man told me his wheat would not be more than half a crop owing to the work of this insect. Would you kindly let me know what it is? It was not noticed until cutting commenced'.—R. W. NEILL, M.D.

'Pilot Mound, Man.—A considerable quantity of the wheat is breaking down badly at the second joint. I was attributing the cause to the straw being weak, owing to rust and showery weather making it softer than usual. I have examined some of the broken straws and found one containing a chrysalis, which I enclose. I hope the western wheat fields are not going to be troubled with weevil or any kindred pest. The wheat crop in this district is practically all in stook. Several were thinking that it is always better to begin on the green side as a very severe wind storm seemed to have broken the straw down.'—D. A. STEWART.

'Portage la Prairie, Man.—As to the extent of the damage by the Hessian Fly, it is very uncertain, some districts were more seriously affected than others. We had several light hailstorms here and there, and many farmers thought they were slightly damaged, but I now think that the damage was caused by the Hessian Fly. I find that the yield is not up to the expectations of the farmers, more especially in the older districts, and I am convinced that it was the Hessian Fly that reduced the yield. But we have been blessed with the most uniform good crop I have ever seen in the province, and hence the slight damage done is not seriously felt. The weather has been, and is yet, simply grand. I found in gathering these specimens I send, that they were more plentiful in late grain than in earlier, also the last heads to come out were the most affected.'—CHARLES BRAITHWAITE.

As stated above, last season is the first in which the Hessian Fly is known to have done harm to crops in Manitoba, and many farmers did not recognize the insect until the matter was brought before them by discussion in the daily journals and agricultural press. With a view to gathering as much information as possible about the occurrence and extent of injury, a series of questions was submitted by the *Farmer's Advocate* to its readers, and answers were received from many of them. Some of these answers were published in the issue of December 5, from which it would appear that the loss, according to locality, was from 5 to 25 per cent of the crop, and that the attack was general, irrespective of the nature and condition of the soil, or the time of seeding. Nevertheless farmers in different localities held strong opinions that there were decided differences, some stating that early sown grain was exempt from attack, while others thought the opposite. Mr. W. R. Graham, Superintendent of the Stony Mountain Penitentiary farm, Manitoba, stated to me on October 4, 1899, that the Hessian Fly did not attack his early sown wheat at all, and he thought this was general throughout his neighbourhood, that in 1899 early sown wheat was much less attacked than that which was sown late and held back by the late season.

In answer to the questions in the *Farmer's Advocate*, Mr. R. W. Greig, of Otterburn, reports that late-growing grain suffered most, although, in some cases, that which was sown very early was injured more than some of that which was put in late. Mr. H. O. Ayearst, St. Paul's municipality, reports wheat on new land as 'badly damaged, at least 25 per cent of the crop; no injury on old land, new land only being injured.' On the other hand, Mr. S. R. Henderson, of Kildonan, reports it to have been 'worst on old land that had been summer-fallowed, with surface cultivation in the spring, and sown early.' Mr. Robert Fisher, of Springfield, says: 'I could see no difference on old land or new, fallow or stubble, fall or spring ploughing, or in early or late sowing, though none of our sowing was very early. My own crop was seriously injured by the fly, 8 to 18 per cent of the whole crop being destroyed.'

The extent of injury was doubtless due to the condition of the wheat plant at the time the females were laying their eggs. The injury by the maggots of the summer brood is, as a rule, at the lowest joints of the stems, and, as upon hatching the young maggots work their way down to the base of the leaf upon which the eggs were laid, it would indicate that the plants which showed injury were those of which the stems were just shooting up at the time the eggs were laid. At the same time, it must be remem-

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bered that there is on spring wheat in spring an early attack at the roots similar to that on fall wheat in autumn, by which very large numbers of wheat plants are destroyed without making stems at all. This attack is, as a rule, not noticed by farmers, because the plants which are left living, stool out more and fill up the gaps.

In a field which I had under constant observation during the summer of 1890, many plants were entirely killed by the spring attack, and others bore only a single weakly stem, most of the shoots having been destroyed; but, from the stooling of the uninjured plants, the general appearance of the field was that of a fair crop, and none of the straws could be found containing puparia, showing that all the eggs were laid before the plants began to shoot. Without close observation this attack would have been overlooked and would not, in all likelihood, have been noticed by farmers. Nevertheless the puparia of the insects which had done the harm, were still in the fields to emerge later and carry on the injury. This same state of affairs may have been the case in Manitoba last year, and much injury then done which was unnoticed. Although not detected, the Hessian Fly must certainly have been present in Manitoba in considerable numbers last year for eggs to have been laid over such a wide area. I have no doubt from an examination of specimens collected in various parts of Manitoba last autumn, that in that province there is only one brood of the Hessian Fly. This insect confines itself in a remarkable degree to the wheat plant, and, although barley and rye are occasionally attacked, this is exceptional; the very rare occurrence of pupæ in timothy, which has been recorded, must be regarded as quite accidental. No fall grain of any kind is grown in Manitoba, and puparia formed in the straws last summer still (December 30, 1899) contain living larvæ in good condition.

Prof. F. M. Webster, the author of most valuable studies on wheat pests, has maintained for many years that the Hessian Fly would be found to be single-brooded when a point sufficiently far north or south of its metropolis, or centre of distribution, was reached, the extremes either of cold or heat preventing the production of food in suitable condition for the second brood, the summer brood instead of emerging in autumn hibernating as flax seeds in the north and in the south remaining in a quiescent condition (æstivating) as flax-seeds during the hot dry period of the protracted southern summer.

This theory of the insect's power to adapt itself to varying conditions was explicitly set forth by Prof. Webster in Ohio Bulletin No. 51, 1893, and as late as March last the same author writes:—'As you know, I have always questioned the occurrence of a second brood of Hessian Fly so far north as North Dakota, but I have never had an opportunity to substantiate my position. I had hoped that you might settle this Hessian Fly problem, and put the question to rest once for all with respect to the number of broods. The insect certainly occurs in areas where there is no fall wheat, but an abundance of spring wheat, and it does not seem to me possible that it could survive in such localities if it were double-brooded, as there is nothing on which a fall brood could winter over, except the spring wheat stubble.'

The importance of exact knowledge as to the number of broods is seen to be very great when we come to a consideration of remedies. The severity of the attack during the past season and the interest which has been created in the subject, through the agricultural journals, added to the fact that the weather has been most propitious this year for autumn work, have induced farmers to make themselves acquainted with the natural history of the Hessian Fly, and to adopt the methods which experience has shown are the best: namely, to burn over the stubble when possible before ploughing, and, at any rate, to plough down deeply all stubble this autumn or before the season for the flies to appear next spring.

As Mr. Greig has stated in the *Farmer's Advocate* for October 20:—'Whether or not the stubble is burned off, the land should be carefully ploughed. Even with no Hessian Fly, careful ploughing is really one of the great essentials to a successful crop. The work cannot be too well done. Not only does good ploughing leave the land in better shape and kill more weeds, but it greatly reduces the amount of harrowing and after work necessary to get the land into the best condition for the seed; and no doubt grain that comes away vigorously and early, and makes rapid growth, has more chances of escaping this or any other pest.'

The following article was published in the *Farmers' Advocate* for September 15, 1899, and similar articles were prepared for the *Nor-West Farmer* and other Manitoban papers:—

THE HESSIAN FLY.

During the past season rather extensive injury has been wrought by that old-time enemy of the wheat-grower, the Hessian Fly. From Western Ontario comes intelligence of the worst attack upon fall wheat, and the question is asked by some farmers there, whether it would not be well to discontinue altogether for a season the cultivation of fall wheat. The most serious injury and the attack of by far the greatest importance as pointing to future possibilities of loss from the Hessian Fly is reported from the Province of Manitoba, by Mr. George H. Greig, the Manitoba editor of the *Farmer's Advocate*. Inquiries and specimens have been received from almost all parts of the province, and from as far west as Moose Jaw in the Territories. Correspondents estimate the loss at between 5 and 20 per cent. This, of course, is all in spring wheat, as in the west no grain is sown in the autumn.

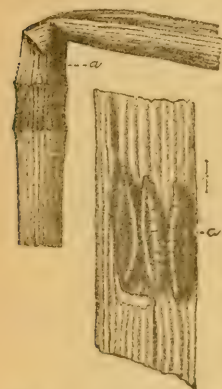


Fig. 3.—Hessian Fly: injured wheat-stem; three puparia enlarged.

The life history of the Hessian Fly is well known. The effects of the injurious work of the maggots on fall wheat can be recognized in the spring of the year by one or more dead shoots or whole plants in wheat fields. Upon examining these plants the characteristic pupa-cases, which resemble closely small elongated flax seeds, may be found in the crowns of the injured plants. Sometimes three or four specimens will occur beneath the leaf-sheaths of a single shoot. The flies from this brood emerge in the spring and lay their eggs upon the leaves of the shooting grain, and later, as at the present time in Manitoba, the same flax-seed-like pupa-cases described above and shown at Fig. 3 may be found above (as a rule, but occasionally higher), the first or second joints of the stems of barley, rye and wheat, where they lie between the base of the leaf-sheath and the stem, somewhat sunk in the tissues, so as to give the appearance of being actually inside the stem. During their growth the maggots have lived at the expense of the wheat plant, sucking the sap, so that the stems are weakened and frequently fall down, bending over just above the point of attack. This is well shown at Fig. 3a, and by it the presence of this enemy will probably be recognized by many Manitoba farmers who may have overlooked it in their crop. In Manitoba, it is most probably the case that there is only one brood of the Hessian Fly in the year, the winter being passed in the 'flax-seed' condition, for the most part in the stubble, but also to some extent in the straw which was harvested. Further south than Manitoba there are two distinct broods.

The perfect insect, a tiny blackish gnat, not expanding more than a quarter of an inch from tip to tip of its wings, appears in May and June and lays its eggs, which produce the summer stem-attacking brood. In Manitoba the flies from this brood do not emerge until the following spring, but in Ontario they appear in August and until about the middle of September, and the females lay their minute scarlet eggs upon the inside crease of the leaves of early-sown fall wheat. The young maggots, upon hatching, work their way down to the axils of the leaves, where the injury to the plant is done. Most of these maggots become full grown before winter sets in, and assume the 'flax-seed' condition.

Remedies.—1. Late sowing.—With regard to fall wheat, the postponement of seed-ing until after the third week in September delays the appearance of the young plants above the ground until all the egg-laying flies of the second brood are dead. In cases where fall wheat has been sown in August and is already well up, it will be well this year, in such localities as the Hessian Fly is known to have been present, to feed off the young grain with sheep. In this way many of the eggs, it is claimed, are eaten with the leaves of the wheat. Care must be taken that the fields are not cropped too closely or too late in the season.

2. Burning refuse.—Many of the 'flax-seeds' of the summer brood are carried with the straw, and at threshing are dislodged and thrown down beneath the machine,

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among the rubbish, or are left in the straw. All screenings and dust should therefore be destroyed carefully, and all straw should be either used during the winter or burnt before spring.

3. Fertilizers.—When it is known that a young crop of fall wheat has been injured by the Hessian Fly, it is a good plan to apply, the following spring, a light dressing of some quick-acting special fertilizer in order to invigorate the plants.

4. Treatment of stubble.—As the Hessian Fly is undoubtedly restricted in Manitoba to the summer straw-attacking brood, the remedy is simple, and, if persisted in, I cannot think that the Hessian Fly need ever become a serious menace to western wheat-growers. The insects passing the winter for the most part in the stubble and not appearing until the following spring, when there are growing wheat plants for the females to lay their eggs upon, if the stubble be burnt over or plowed down in autumn and the straw fed to stock or burnt at any time before the flies emerge in the spring, this dire enemy of the wheat-grower should be easily controlled.

It was to be expected, as stated in my last annual report (*Exp. Farm Report*, 1898, p. 174), that at no very distant date we might have trouble from the Hessian Fly in our western wheat fields, for Prof. Lugger has recorded that in the Red River valley, in Minnesota, where the conditions are similar to those of a large part of Manitoba, a large area of that state was infested in 1896, the damage in some places amounting to more than 25 per cent, and that on an average the farmers lost from 5 to 10 per cent of their entire wheat crop.—J. FLETCHER.



Fig. 4.—Hessian fly: puparium containing six cocoons of *Polygnotus hiemalis*—enlarged.

One of the chief reasons why the Hessian Fly has not been very injurious in Minnesota since 1896 is, Prof. Lugger thinks, the abundance of parasites which appeared in 1897. A few of these friends of the farmer (*Polygnotus hiemalis*, Forbes) have been found in infested straws sent to me by Mr. W. W. Fraser from Emerson, Man. Three specimens of the most important parasite of the Hessian Fly, *Bæotomus (Merisus) destructor*, Say, were bred by Professor Lugger from straws sent to him by Mr. Chas. Braithwaite from Portage la Prai-

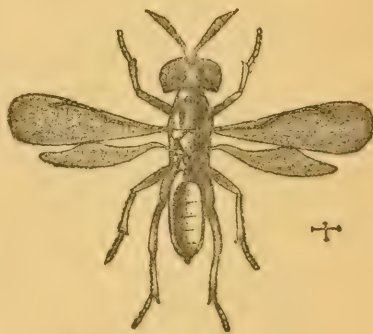


Fig. 5.—*Bæotomus destructor*, female—enlarged.

rie. It is to be hoped that these parasites will increase largely in numbers. Unfortunately, however, Professor Lugger writes under date October 20, that in Minnesota 'Parasites of the Hessian Fly, are decidedly scarce this year. From 40 different places (about 75 infested straws from each) I have raised less than 25 parasites. Nearly



Fig. 6.—*Eupelmus Allynii*, male—enlarged.

Entedon, possibly *E. metallicus*, Nees. Cuts 3, 4, 5 & 6, used here have been kindly lent by

all of them came from straw obtained from near Crookston, Polk Co., Minn. South of that place I have found none, north but a few.' Manitoba material received from Mr. Braithwaite contained three specimens of the females of *Bæotomus destructor*. On the other hand, in Prince Edward Island a much more satisfactory state of affairs may be reported; for, from a packet of infested straws from Mr. Wyatt received during 1898, no less than five different kinds of parasites were reared, viz:—*Bæotomus destructor*, *Eupelmus Allynii*, French, *Eupelmus*, n. sp., *Tetrastichus productus*, Riley, and

Prof. Lugg. Reports from Prince Edward Island this year mention serious injury by Hessian Fly; this is most probably owing to the increase in the numbers of these parasitic species.

THE DESTRUCTIVE PEA APHIS

(*Nectarophora destructor*, Jnsn.).

Attack.—Pale green plant-lice with legs darkened, particularly at the joints, honey tubes very long; clustered in enormous numbers at the tips of the shoots, beneath the leaves, and sometimes over the whole plants of field peas, as well as upon the flowering Sweet Peas. These insects appear suddenly in large numbers and very soon kill the plants by sucking their sap. The winged specimens are rather large for aphides, being about one-eighth of an inch in length, with a wing expanse of nearly one-quarter of an inch.

One of the most remarkable outbreaks of the year, which extended over a very wide area, was by a previously undescribed species of plant-louse. This was reported from various places in Canada from the Maritime Provinces to Western Ontario, even extending up into the sparsely settled country in the Nipissing District. It also occurred in destructive numbers in many parts of the United States; Prof. Johnson, of Maryland, the describer of the species, who read a paper on the subject at the last meeting of the Association of Economic Entomologists, says:—

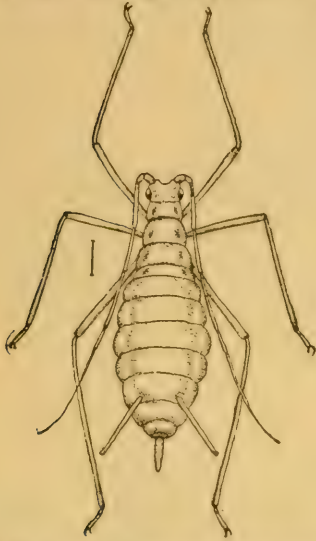


Fig. 7.—The Destructive Pea Aphis: wingless viviparous female—enlarged.



Fig. 8.—The Destructive Pea Aphis: winged viviparous female—enlarged.
(Figs. 7 and 8, after Johnson, Md. Agr. Exp. Sta. Bul. 63.)

‘Pea growers nearly everywhere along the Atlantic coast consider that they have been visited by a veritable scourge. The attack has not been confined to Maryland alone, but I have records of the occurrence of the pea-louse in Delaware, New Jersey, New York (Long Island), Pennsylvania, Virginia, North Carolina and Connecticut.

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'The growing of peas in Maryland is a very important industry, and reliable conservative authorities place the loss this season at \$3,000,000, the principal cause being the pea-louse. In many cases the destruction was complete, varying from mere garden patches to hundreds of acres.'

The Destructive Pea Aphis appeared in alarming numbers in the United States this year much earlier in the season than was the case in Canada, and consequently the loss to pea growers was greater, because in Canadian fields the seeds inside the pods in some instances had become fully formed before the Aphis appeared. By the end of May in Maryland many acres of peas were already destroyed, but in Canada it was not until the very end of July that the first complaints of injury began to be received.

The following extracts from some of the letters of correspondents will give an idea of the suddenness with which this insect appeared and the extent of its injuries:—

'Alberton, P.E.I., Oct. 31.—It appeared as if nature had striven this year to multiply aphides to infest every kind of plant. All the fruit trees were infested, the whole range of garden truck had its load, and out in the fields they so multiplied on peas sown without grain as to flatten vigorous crops to the ground and completely ruin them. The rain prevented the kerosene emulsion from doing its work.'—REV. A. E. BURKE.

'New Minas (Kings Co.), N.S., July 29.—I observed to-day when walking through my peas, that there were swarms of active flies somewhat resembling house flies, only very shiny. (These were evidently Syrphus flies, the larvæ of which do such good service by feeding upon plant-lice, as stated further on.—J.F.) On looking closely, I found that the vines, including the young pods, were all covered with creeping insects. I send you some of these, and shall be glad to know anything you can tell me about them, for I fear that they will destroy the crop.'—BUDD BISHOP.

'Nappan (Cumberland Co.), N.S., August 8.—I send you samples of the work of the insect which is destroying our peas. I am very much afraid that it is going to ruin completely our experimental pea plots. These insects increase and spread with amazing rapidity. On Aug. 2, I went carefully over all the pea plots and noticed that there were a few of these insects distributed all over them. By the 6th they were in great numbers in spots all over the field, and now, two days later, they cover the whole vines, so that the whole crop will surely be ruined. The lice cluster upon, and completely hide the tender parts of the stalk, the blossoms and the under surfaces of the leaves. On account of their being mostly on the undersides of the leaves, it is hard to get at them with any kind of spray. This aphis seems to be very much like the one we sometimes have on plum trees, but it is now much more numerous than anything I have ever seen on plum trees, for these literally cover the whole field and they only take about 10 days from the time they first appear to suck the life out of the plants and leave white dead stalks. I am afraid this is a very serious matter for our pea crop.'—R. ROBERTSON, *Superintendent Expt'l Farm.*

Later in the season Mr. Robertson wrote under date of Dec. 15: 'The worst insect of the year with us was the Pea Aphis which was not only extremely abundant and destructive on our own farm; but judging from the number of inquiries by visitors at Nappan, about what was termed in a general way 'the blight,' it must have been very prevalent in many parts of New Brunswick and Nova Scotia.'

'Adamsville (Kent Co.), N.B., Aug. 18.—I send you herewith a stalk of pea covered with insects. All the fields of peas around here are covered with them and they kill the peas outright. I have a field infested; when I first noticed them was when the peas were in blossom. They appeared to be withered, so I examined them closely and found that they were covered with these little insects. The plants are now all withered and look as if they were rusted. I have found the insect also on vetches here. I inclose you a sample of these also; they are destroyed in the same way as the peas. I am cutting them at once for fodder. I would like to know if it will be injurious in any way to feed these vetches to cattle or horses. This enemy of the pea and vetches has never been noticed in this section before.'—A. J. ARSENAULT.

'Elmhurst (King's Co.), N.B.—Our field peas shortly after the formation of the pods became infested with green lice, which were to be found on all parts of the plants,

but especially thick on the pods. The plants then turned brown and dried up so as to be useless as fodder. Is there any remedy for this pest? Would it be any benefit to have the next crop at some distance from the one infested?—C. R. PETERS.

'Thornloe (Nipissing District), Ont., Sept. 14.—My crop of peas was entirely ruined by plant-lice about half the size of a grain of wheat, which were on the plants by millions. These peas were the first ever sown on my farm, as I only came here last fall. I would like to know if this pest is often found in open country. The clearing in this part amounts to only a few acres here and there, in an immense forest of rather light young timber. If it had not been for these lice, my peas would have been a good crop, as the land suits peas, so far as they have been tried by my neighbours.'—SAMUEL REID.

'Toronto (York Co.), Ont.—I am greatly troubled this summer with green-flies, upon my sweet peas. They are in great numbers; I never saw so many as there are this year. When I went along the vines with the spray from the hose, they would fall on the ground so thickly as to make it green. There was another kind which attacked the plants under the ground clinging to the roots. This is of a brick red colour but otherwise resembles very closely the green-flies which were so numerous on the leaves and stems. When I pulled up some sickly vines last summer, I also found some of these insects clinging to the roots. These latter are not so numerous as the green ones mentioned above. Wireworms, cutworms and red spiders have also given me a great deal of trouble on my sweet peas this year.'—ED. LEADLEY.

'Freeman (Halton Co.), Ont., Aug. 7.—I send a sample of peas heavily infested with plant-lice. These are from a 14-acre field belonging to my cousin, F. W. Fisher, at Burlington, close to here. This is a fair sample; I have never seen anything like it before and should like to know if it is common. I should like to know what variety of aphid this is, for it looks as if the whole crop would be lost.'—GEO. E. FISHER.

This pea aphid was also very destructive to both field peas and Sweet Peas at Ottawa, but in the case of the field peas the outbreak occurred so late in the season that most varieties ripened before much harm was done. Sweet Peas in many gardens were badly attacked. Perhaps the worst case of infestation was upon a hedge of Sweet Peas planted rather late upon the Central Experimental Farm, where an excellent opportunity was afforded of watching the development of the plant-lice and also of a war which was waged strenuously against them by various kinds of parasites. The plant-lice clustered thickly around the young shoots and towards the ends of the branches, stunting the growth of the plants very much and preventing them from flowering. They appeared at Ottawa in the middle of August, and some specimens could be found right up to the hard frosts of late autumn. By the beginning of September several kinds of predaceous insects, such as lace-winged flies, lady-bird beetles and *Syrphus* flies, began to appear in large numbers, and from that time on the numbers of the plant-lice decreased rapidly. When the lady-bird beetles began to pupate, they crawled up above the vines and attached themselves to the wire netting intended for the sweet peas to climb over. This they studded so thickly as to be noticeable from a considerable distance. The species which were most numerous were *Hippodamia convergens*, Guér., and *Coccinella 9-notata*, Hbst. Next to these were the larvæ of *Syrphus ribesii*, L. This latter, however, was unfortunately rather commonly attacked by the hymenopterous parasite *Bassus latatorius*, Fab., which again in its turn occasionally fell prey to the small Chalcid *Isocentrus vulgaris*, Walk. In addition to the above parasites many specimens of *Praon cerasaphis*, Fitch, were bred from material collected at Ottawa. In one garden another minute Braconid, a new species of *Aphidius*, which has been named by Mr. Ashmead, of Washington, *Aphidius Fletcheri*, did good service. The empty shells—the bodies of the hosts—from which the parasites had emerged, were very abundant on the plants. These hymenopterous parasites were kindly identified by Dr. Howard, U.S. Entomologist.

I had not an opportunity to examine material from all the localities at which this plant-louse occurred in Canada during the past summer, but parasites in numbers were found at most places; and, if the Ottawa outbreak may be taken as a guide, added to the fact that although so injurious this year the Destructive Pea Aphid has never appeared in destructive numbers before, we have reason to hope that even next year it may not again be the cause of serious loss. It must be noted, however, that the occur-

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rence of the parasites seems to have been extremely restricted as to locality. The *Aphidius* mentioned above was very abundant in the garden of Mr. Collingwood Schreiber at Ottawa, while hardly a specimen could be found at the Central Experimental Farm, only two miles distant, where another parasite, *Praon cerasaphis*, took its place as the abundant species. Prof. Johnson, who has made careful studies of the insect in the United States, expressly states that he has been unable to secure a single true parasite from the many hundreds of specimens he has attempted to breed. On the other hand, he found the predaceous insects feeding upon them in some localities in extraordinary numbers. Speaking of the larvæ of one of the *Syrphus* flies, or Hovering flies, as they are sometimes called, he mentions one instance, as reported to him by a reliable grower, that 25 bushels of the larvæ were run through his screens the last few days they were working at threshing. At the same time, hardly a Destructive Pea Aphis could be found where only a few days previously they were present in countless millions. The *Syrphus* flies are very active, with bodies as a rule bronzed and marked with yellow, almost like wasps. They may be recognized by their habit of remaining apparently stationary, poised in mid air for a few seconds, and then dashing off a few feet to take up another position in the same manner. The adult flies do not themselves eat the plant-lice but their elongated leech-like larvæ live entirely upon them. The eggs are laid near the colonies, and when the young grubs hatch they crawl among the plant-lice, and having transfixed one they raise it up and hold it aloft until they have sucked all the juices out of the body. They are voracious and grow rapidly, destroying a very large number of plant-lice in a day. There are several species, all of which feed upon aphides. When full grown the larvæ harden into pear-shaped puparia, and the flies emerge soon afterwards. There are several broods in a season. The lady-bird



Fig. 9.—Fifteen-spotted Lady-bird: *a*, larva; *b*, pupa.

beetles are such good friends of the farmer and gardener that everybody ought to know their appearance, but there is never a year passes but some one reports having taken great pains to destroy them when they have been found in numbers, believing them to be enemies. The grubs have aptly been said to somewhat resemble small alligators. The lace-winged flies also have larvæ of somewhat the same appearance, but smaller. They are armed with long hollow jaws with which they suck out the juices of the plant-lice, and are equally voracious with the lady-bird beetles. There are many points of interest about these lace-winged flies. The eggs are beautiful objects, being attached to the end of slender upright threads. The perfect insects have gauzy lace-like wings which, when not in use, are folded together like a pent-house over the back. Their eyes are bright golden bronze.

In Mr. Leadley's letter above quoted, mention is made by him of a bright red aphid found by him on the roots of his sweet peas. Specimens of this same aphid were sent in last year by Messrs. Steele Briggs Co., of Toronto, but the species was not identified from the few specimens sent, as no winged individuals could be found. Upon the outbreak of the Destructive Pea Aphis last summer it was thought that perhaps the species concerned might be the European *Siphonophora pisi*, Kalt., but Dr. Howard informs me that this latter is a much smaller species.

Remedies.—When an insect appears suddenly in the large numbers that the Destructive Pea Aphis did during the past season and increases with such rapidity, it is evident that it would be impossible to apply any remedy over such a large acreage as was simultaneously attacked, in most places where this insect occurred; but upon green peas and the flowering sweet peas in gardens the ordinary remedies used against other plant-lice were found to be quite effective against this one also. Upon the Central Experimental Farm the Horticulturist had the plants sprayed with a tobacco-and-soap wash made of 10 lbs. of tobacco leaves in half a barrel of water, the liquid from which was strained off after a few hours, and two pounds of whale-oil soap were added. When the soap was all dissolved, water was added to make 40 gallons, and the liquid was then applied with a spraying pump. Most of the plant-lice were found to be dead two

days afterwards and on such parts of the rows as received two applications, the vines were quite cleared of the insects.

THE ASPARAGUS BEETLES

(*Crioceris asparagi*, L., and *C. 12-punctata*, L.).

Attack.—The Common Asparagus Beetle—Slender black beetles about $\frac{1}{4}$ of an inch



Fig. 10.—The Common Asparagus Beetle: different stages on asparagus spray.
to have occasioned the loss of over a third of the crops of certain localities, such loss being estimated at \$50,000.”

The Common Asparagus Beetle is now found as an enemy of the asparagus plant in most of the North-eastern States, lying in the Upper Austral faunal zone. Its distribution is by means of the adult beetles flying, and by their transportation to new localities with the roots of asparagus.

Last year it was reported by Mr. A. H. Kilman (*Rep. Ent. Soc. Ont.*, 1898) that it had reached the Niagara River in the State of New York, and during the past summer it occurred in injurious numbers in the Niagara peninsula of Ontario. The first Canadian specimens sent to me were from Mr. E. Arnold, of Queenston (Lincoln Co.), Ont., and upon enquiry I learn that many asparagus beds in the Niagara district were much injured last season. Mr. John Dearness, a member of the San José Scale Commission, informed me that during 1899 he had seen the beetles abundant and injurious near St. Catharines, Ont., where also he had found that the beds were badly affected with the Asparagus Rust (*Puccinia asparagi*, DC.)

in length, conspicuously marked with six white blotches on the back and a red border to the neck and elytra, or wing-cases, appearing in the early spring and eating into the asparagus shoots, upon which they lay their greenish black eggs. The grubs, which hatch from these eggs, are dark olive and slug-like. These also attack the shoots. The Twelve-spotted Asparagus Beetle:—Occurring sometimes with the above, are beetles of about the same size, but slightly broader and of a uniform reddish orange colour, with twelve black spots upon the wing-cases. The grubs somewhat similar to those of the Common Asparagus Beetle, but of a dirty yellowish colour, feed inside the berries of asparagus.

Both kinds of Asparagus Beetles have been common in some parts of the Eastern United States for many years. The former obtained a permanent foothold on this continent in 1856, and the latter in 1881.

THE COMMON ASPARAGUS BEETLE.—The first record of this insect, as a crop pest, in America was at Astoria, near New York city, in 1862. In a most complete article on the subject, by Mr. F. H. Chittenden in the United States *Year Book* for 1896, it is stated as follows:—“From the seat of its introduction at Astoria, forty years ago, it soon spread to the asparagus farms of Queen’s County, N.Y., and by 1862 it was reported

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Fig. 11.—The Common Asparagus Beetle—enlarged.

The Common Asparagus Beetle is a narrow black beetle a little less than $\frac{1}{2}$ of an inch in length and very prettily marked. The head legs and feelers are blue black, the thorax is chesnut red, the wing-cases are mainly blue black with six silvery white spots and are widely bordered around their edges with orange red. The markings on the wing-cases have, as shown in the illustration, somewhat the appearance of a double black cross. The wing-cases are shining and bear several longitudinal lines of deep punctures. This insect injures asparagus both in the larval and perfect states. The perfect beetles pass the winter hidden beneath rubbish, loose bark of trees or stones, and appear just at the same time as the asparagus comes up, when they fly to the buds and begin to eat into the succulent shoots, upon which also they lay their eggs. These are brownish black in colour, large, compared with the size of the beetle, being nearly one-sixteenth of an inch in length, nearly three times as high as wide, and stand out in every direction from the shoots. They are attached by one end and are laid on the shoots, and later on the foliage, in rows of 6 or 7 eggs. The young grubs hatch

in a few days and are grayish with black shiny heads and legs, admirably shown in figure 12 c. They at once attack the young shoots, eating into them, and when touched these larvæ also emit a dirty blackish fluid which soils the shoots, spoiling them for the market. They are very voracious and grow rapidly, becoming full grown in about a fortnight, when they are dark greenish-gray, shiny bag-like grubs (Fig. 12d), which crawl quickly but clumsily, drawing up their bodies and attaching themselves by their

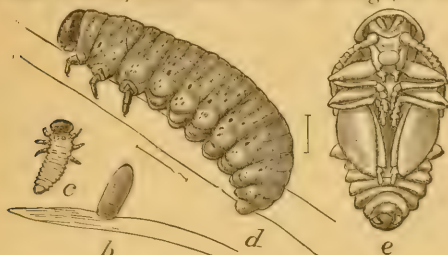


Fig. 12.—The Common Asparagus Beetle: b, egg; c, d, larvæ; e, pupa—enlarged.

anal prolegs to the object upon which they are crawling. When ready to pupate, the grubs burrow into the ground and change to yellowish pupæ (Fig. 12e). In about a month from the time the eggs are laid, according to Fitch, the perfect beetles appear. There are probably two broods in a season in Canada. Mr. Chittenden says (*loc. cit.*): "The minimum life-cycle period of the species in the District of Columbia and southward is about three weeks from the time the egg is laid. In the colder climate of New England and in spring and summer weather the development from the egg to beetle will require from four to perhaps seven weeks. In its northern range two and perhaps three broods are usually produced, and further south there is a possibility of four or five generations each year."



Fig. 13.—Egg of Spotted Asparagus Beetle—enlarged.

THE TWELVE-SPOTTED ASPARAGUS BEETLE is about the same length as the above

but is a slightly broader insect. The general colour is orange red, and the wing-cases bear 12 round black spots, the knees are also marked with black. This species was a much later introduction into America than the Common Asparagus Beetle, not having been noticed until 1881, when it was found in considerable numbers at Baltimore, Md., by Prof. Otto Lügger. It has, however, spread rapidly and now occurs with, and covers almost the same area as, the Common Asparagus Beetle.

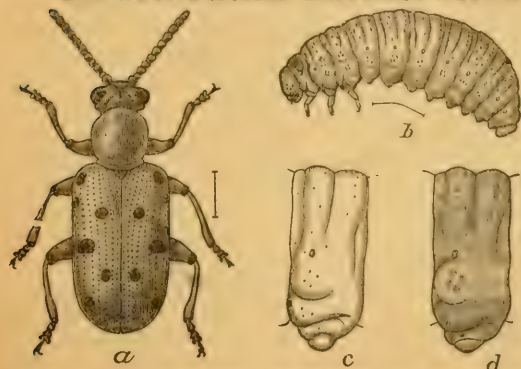


Fig. 14.—The Twelve-spotted Asparagus Beetle: a, beetle; b, larva; c, 2nd abdominal segment of larva; d, do. of *O. asparagi*—a, b, enlarged; c, d, more enlarged.

In the Canadian occurrence of these beetles during the past summer, both

species were about equally numerous on the infested beds. In the United States the 12-spotted Asparagus Beetle is regarded as rarer and less injurious than the common species. Although the hibernated beetles appear equally early in the season with the Common Asparagus Beetle and attack the young shoots, Mr. Chittenden states (*Bull. 10*, n.s., U.S. Div. Ent.) that the larvæ live chiefly in the green and ripe fruit of the Asparagus. There are, however, several records of serious injury by this species in early spring to the growing crop. Mr. Chittenden has described the eggs and the method of oviposition as different from those of the Common Asparagus Beetle (*Bull. 10*). Instead of being attached by one end and having the surface sculptured, these are attached to the plant by their sides as shown natural size and enlarged (Fig. 14). The larva also differs much (Fig. 14 *b, c*). Mr. Chittenden thinks that these larvæ live almost entirely in the berries, each one passing from one that it has excavated to a fresh one when in need of food. The berry drops off soon after the larva enters it, and the first brood of the beetles matures long before the berries redden on the plants. The same writer also gives the following very accurate description of some of the habits:—It is about the same size and proportions as the larva of the common species but is readily separable by its ochraceous orange colour. The ground colour is light yellowish cream overlaid with ochraceous orange; the head, with the exception of the mouth parts, is also ochraceous. Thoracic plate dark brown divided into two parts.

Mr. Chittenden gives the following very accurate description of some of the habits of these insects:—"The Twelve-spotted Asparagus beetle, as it occurs on the plant when in fruit, very closely resembles at a little distance the ripening asparagus berries. The Common Asparagus Beetle, as is well known, dodges around a stem like a squirrel when disturbed, but the Twelve-spotted form appears to trust to flight, taking wing more readily than the other. Both species make a loud creaking sound when handled. This stridulation is produced by rubbing the tip of the abdomen against the elytra."

Figures 10 to 14 in this article have been kindly lent by Dr. L. O. Howard the U. S. Entomologist.

Remedies.—Owing to the inadvisability of applying any poisonous substances to the young shoots in spring, at the time they are being cut for the market, with the object of destroying the hibernated beetles, remedies should be directed mainly against the larvæ which appear on the plants during the summer. There are many useful measures which may be taken to control these insects:—

1. Dusting with lime.—Perhaps the most effective is the destruction of the larvæ by dusting the plants at short intervals, every three or four days, with fresh air-slaked lime, which adheres to their slimy bodies and quickly kills all those with which it comes into contact. This is best done early in the morning when dew is on the plants.

2. Arsenites.—Active poisons, as a mixture of Paris green and flour, or Paris green and lime, applied dry to the grown stems in the same way as for the Colorado Potato Beetle, answer well, and kill not only by contact with the larvæ but destroy both the larvæ and the perfect beetles when they eat the poisoned foliage.

3. Beating.—The beetles and many larvæ may be beaten from the asparagus plants

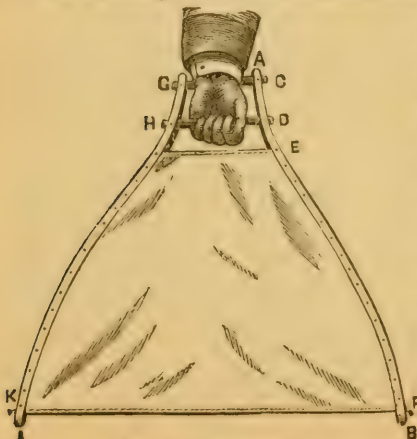


Fig. 15.—Beating net.

into nets or broad pans containing water and coal oil. Nets made specially for the purpose are most convenient. A good pattern for an easily made net which can be held beneath the plants with one hand while the insects are beaten down on to it with a light rod, has a stick on each side and a flat sheet of cotton between, three feet wide at the top and one foot at the bottom (Fig. 15). Two cross bars close together at the base allow of this net being easily held by taking the upper bar in the left hand, so that the lower bar rests against the back of the wrist. The larvæ may also be brushed off the plant with a stick, and, if this is done in the middle of a hot day, it is claimed that few of them get back again, a very short time in the hot sun proving fatal.

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4. Traps.—During the cutting season the crop should be kept well down, a few shoots being left to attract the egg-laying females. In a week or so these should be cut and destroyed, other shoots being left to take their place. Young beds not old enough to be cut should be kept dusted with lime.

5. Poultry.—Chickens and ducks when available are very useful in eating the beetles when they first appear in spring, and it is claimed they do no harm to the beds.

THE BLACK VIOLET APHIS

(*Rhopalosiphum viola*, Pergande).

Attack.—Dark coloured plant-lice clustering beneath and about the bases of the leaves and penetrating into the heart of violet plants grown under glass for winter flowering, sucking the plants and injuring them so as to prevent them from flowering, the growth being stunted and the leaves curled up.

During the convention of the Canadian Horticultural Society held at Ottawa last September, Mr. J. H. Dunlop, a large florist of Toronto and an extensive grower of violets under glass, asked what could be done to prevent the attacks upon his violet plants by the Black Violet Aphis, which he stated had been a cause of considerable loss in his greenhouses. On October 13, a visit was made to Mr. Dunlop's establishment by Mr. Arthur Gibson, of this Division, and specimens of the plant-louse mentioned were secured. These have since been bred in confinement, and specimens have been kindly identified by Mr. T. Pergande, through Dr. Howard's courtesy, as *Rhopalosiphum viola*, a species lately described by Mr. Pergande. As a plant-louse, when examined closely, this is a very beautiful species, the body being of a brownish green, marked with black patches, and the stigma and all the veins of the wings are clearly and broadly marked with black. At the time of Mr. Gibson's visit, the aphides were very numerous, almost every plant examined in most of the violet houses being found to be infested. Very little systematic work had been done at that time towards controlling these insects. Mr. Dunlop was of the opinion that, as is known to be the case, the violet is easily injured by tobacco fumigation; consequently, little smoking had been done. Later, however, the attack became more serious and was the cause of a loss in this year's violet crop, estimated at \$1,000. Fumigation with tobacco had been resorted to for three weeks at intervals of one week apart, at the time of a second visit paid by Mr. Gibson on December 26. Powdered tobacco stems had also been dusted over some of the plants. These applications had killed many of the aphides, and the insects were then practically under control, but the plants were showing many spotted leaves. The treatment of violet plants with tobacco is considered objectionable by the best growers. Mr. B. T. Galloway, Chief of the United States Division of Vegetable Physiology, who has studied the commercial culture of violets and is the author of an excellent book upon that subject, writes as follows with regard to some leaves which were submitted to him from Mr. Dunlop's houses where the fumigation had been done:—'The violet leaves are affected with the well-known spot which is very apt to appear at almost any season of the year under certain conditions. In our experience we have never found it safe to use tobacco in any form on violets; even the very weakest fumigations have a tendency to weaken the foliage and bring on spot. My suggestion in this case would be to thoroughly clean the plants, withhold water from the foliage for two or three weeks and keep a night temperature of about 40 degrees, with a day temperature of 55 or 60 degrees. In other words, attempt to give as good conditions as possible to bring the plants to health.'

Remedies.—For greenhouse plant-lice and certain other insects, the most generally adopted method to prevent such attacks is the fumigation with tobacco in its various forms. In the case of violets, however, as Mr. Galloway states, the tobacco fumigation tends to weaken the foliage and cause the 'spot' to appear. In an excellent bulletin recently issued by the United States Division of Entomology (*Circular No. 37, 2nd*

Series), the use of hydrocyanic acid gas for greenhouse fumigation is recommended, as of particular value to violet growers. Indeed this line of application of the gas is said to have been specially devised for violet houses by Messrs. Woods and Dorsett, the authors of the bulletin, who are officers of the Division of Vegetable Physiology and Pathology, and the latter is a practical violet grower. Careful and exact directions as to the proper way of using the gas, together with the necessary precautions which must be taken to avoid danger to the plants or to the operator, are given. Different plants are liable to injury in a varying degree, so that it becomes necessary to know the strength of the gas which may be used with each class of plants. Many experiments have been tried with this end in view, and directions are given in the bulletin cited for some of the leading greenhouse plants, e.g.:

'Double English Violets.—"Marie Louise," "Lady Campbell," and others. For plant-lice and general fumigation, fifteen-hundredths of a gram of 98 per cent cyanide of potassium for each cubic foot of space is required. The exposure, if made according to directions, will not hurt the plants in any stage of growth. The gas has been used on a large scale in fumigating violets for the past three years with the greatest success, only a few treatments during the season being required. Leaf-eating larvæ, slugs, millipedes, cutworms, &c., when exposed, are killed as well as plant-lice. Red Spiders, however, are not entirely eradicated by the treatment. The foliage of single violets like California and Princess of Wales are sometimes slightly injured by the stronger dose of gas. A weaker dose (one-tenth of a gram cyanide of potassium per cubic foot) should be used when they are to be treated.'

THE CLOVER MITE

(*Bryobia pratensis*, Garman).

Attack.—Reddish brown mites $\frac{1}{25}$ of an inch in length, oval in shape and with remarkably long front legs, causing the leaves of fruit and other trees, as well as of clover, to turn yellow.

This species of mite belongs to the same family of vegetable feeding mites, the *Tetranychidae*, as the ordinary so-called 'Red Spider,' often found on house plants and in conservatories, and which also attacks orchard trees, rose and currant bushes, sweet peas, and other low plants, causing the leaves to assume a sickly appearance and to dry up. The eggs of the Clover Mite frequently come in from inquiring correspondents. They are ruby red in colour, broadly rounded above and comparatively large, about $\frac{1}{100}$ th of an inch in diameter. They are usually deposited in large flat mat-like clusters in and around crotches of the branches of orchard trees, particularly of plum trees, and often in sufficient numbers to give a distinct red colour to the bark. Specimens of eggs were received first from British Columbia, and since then have come from many parts of Ontario, and as far east as Gaspé in the extreme east of the Province of Quebec.

Though spread over such a large territory in Canada, the Clover Mite does not seem to have attracted attention by its injuries anywhere except in British Columbia, until last summer, when the following letter was received:

'Queenston (Lincoln Co.), Ont., July 17.—With this I send you some twigs of some Niagara Plum trees. They are much paler green than others and are evidently affected by some insect, possibly the Red Spider. Did you ever know this insect to work on plum trees in this manner? The entire foliage of large trees seems affected. What had I better do to check it? Is it dangerous?'—C. E. FISHER.

In Canada the Clover Mite passes the winter in the egg state, but in many parts of the United States it has been complained of from time to time in the last ten years as an unwelcome invader of dwelling houses in the mature state, during autumn and winter. The small size of the Clover Mite enables it to go through ordinary wire screens with ease to the serious disquietude of the house-keeper.

The large number of inquiries about this mite, both on account of its invasion of houses in autumn and of its injuries on trees and other plants, made it necessary for the United States Entomologist to publish a special circular on the subject (*Circular No. 19, Second Series*).

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Though the injuries to fruit crops by the Clover Mite have not been serious in Canada east of the Rocky Mountains, a good deal of harm is done in the Pacific States and in British Columbia to many fruit trees, particularly plums, apples, almonds and cherries, and together with other kinds of mites this is often spoken of under the general name of 'Red Spider.' Besides the injuries above referred to, there is no doubt much damage is done by this insect to clovers and grasses which is overlooked.

Remedies.—The protection of fruit trees from the attacks of this mite is not difficult where the winter is chiefly passed in the egg state on the trunks of trees. It has been found that spraying the egg masses during the winter with kerosene emulsion diluted with five parts of water will destroy the eggs without injuring the plants. Their entrance into houses in autumn may be prevented by spraying the lower portions of the buildings with pure kerosene, and, if the mites are found infesting grasses or other plants, these latter should also be sprayed with kerosene emulsion diluted with nine parts of water, to which some finely powdered sulphur can be added with advantage. When the mites have gained access to a house, they may be destroyed by the free use of pyrethrum insect powder or by burning brimstone in the room. Gasoline or benzine may be sprayed over them, but these liquids are dangerous from their extreme inflammability, and hot water frequently applied would answer the same purpose.

THE GREENHOUSE LEAF-TYER

(*Phlyctenia ferrugalis*, Hbn.).

Attack—Slender semi-translucent green caterpillars, when full grown nearly an inch in length, with two distinct black spots close behind the head, the green dorsal vessel showing distinctly down the middle of the back, bordered on each side with a double white band, feeding inside a slight tent made by drawing the sides of leaflets together with silk threads. The cellular tissue of the lower sides only of the leaves is eaten.

During the past summer I had brought to my notice injuries to roses in the greenhouses of Mr. J. H. Dunlop, of Toronto, by the caterpillars of a small European moth, which has been introduced into America for some years and has been occasionally noticed as a greenhouse pest, and on one occasion as injuring celery out of doors in Michigan. Mr. Dunlop first noticed the work of this insect about three years ago, when it destroyed the whole of the roses in one of his houses, and did much harm in others. The only effort to control it was by catching the moths and destroying them. Every year since 1897 the caterpillars have been the cause of some loss. On October 13 last, Mr. Arthur Gibson visited the houses and saw large numbers of the moths flying among the roses and resting on the sides of the house. Living caterpillars were also found of all sizes at this time and appeared to feed almost entirely on the under sides of the leaves, eating away the soft green tissues and spoiling the appearance of the foliage. From the time they hatch until full-grown, the caterpillars live in tents made by drawing down the leaflets of the leaves; the cocoons are spun between the leaves. In a work entitled *Commercial Violet Culture* by Mr. B. T. Galloway, of Washington, it is stated that violets are sometimes attacked during the summer by this insect, the larvæ attacking the leaves and destroying the softer parts, leaving only the skeleton or frame of the tissues. The caterpillars are surrounded by a light web and occasionally two leaves are fastened together to give them protection. It is further stated that the insect never produces serious injury, but it is advisable to watch for it and take such steps for it as may be practicable. The picking of the leaves containing the larvæ is recommended and, if it should become abundant, fumigation with hydrocyanic acid gas.

A second visit was made on December 26, and although the specimens were many fewer, the houses having been carefully gone over, a moth was found flying, and a cocoon containing the living pupa, but no caterpillars. Mr. Dunlop states that the caterpillars may be found all through the winter.

The following description was taken of the larvæ :

Full-grown caterpillar,—Length at rest, $\frac{3}{4}$ of an inch. General appearance: slender, semi-translucent green caterpillars with the dark green dorsal band showing distinctly through the skin, rather fainter on 2nd, 3rd, and 13th segments. This is bordered on each side by a double white sub-dorsal band, which also is rather fainter on the 2nd, 3rd and 13th segments. On the 2nd segment are two distinct black spots, one on each side. Head one-twenty-fifth of an inch in width, smooth and shining, whitish, splashed with light brown on the cheeks, slightly furrowed at vertex, and bearing a few pale hairs. Mandibles brownish; ocelli black. Spiracles white and very small, joined by a faint whitish line. On the 2nd, 3rd and 4th segments this line is represented by a few faint white dots and is obsolete on segment 13. Thoracic feet and prolegs of the same colour as the body; the thoracic feet each bear exteriorly two black dots, one above the other. The whole body is sparsely covered with slender pale hairs, the ventral surface lighter in colour than the dorsal. When at rest these caterpillars have a habit of curling round to the side of the body, their heads and the first three or four segments of the body. The length of the pupal period in October was 17 days.

THE RASPBERRY WEB-WORM

(*Lyda multisignata*, Nort.).

Attack.—Bright green smooth false-caterpillars, when full-grown over half an inch in length, which web together many of the leaves on raspberry canes, making a tent in which several of the caterpillars feed together.

A rather interesting new enemy of the raspberry has for some years occurred at St. John, N.B.; larvæ were received in 1898, from which two males and a large number of female saw-flies were reared last summer. These have been kindly identified by Dr. Howard as *Lyda multisignata*, Nort. The caterpillars when full-grown are over half an inch in length, the head round and smooth, the cheeks and back of the head chestnut brown, as well as the mandibles, and a large round patch in front of the face. Ocelli black. On the segment next to the head is the thoracic shield, which in some specimens is also darkened with brown patches, and on each side of the throat beneath, running across the same segment, from the back of the head to the bases of the first pair of thoracic feet, is a short dark brown chitinous band. Antennæ 7-jointed, and for caterpillars conspicuous. On each side beneath the last segment is also a 3-jointed antenna-like appendage protruding downwards. These appendages in *Lyda* are called abdominal antennæ by Dr. A. S. Packard in his *Text Book of Entomology*, 1898, page 165, and a figure is given of a *Lyda* larva which might almost be used as an illustration for the species under discussion. The upper flap of the last segment is rounded at the tip and bears three dark triangular marks extending from the base towards the apex, but not reaching it; the median, only half the length of the lateral ones; lying in a depression at the extremity, there is also a distinct median dark dot. The lower flap of the last segment, dark brown narrowly margined with green, and as well as the upper, bearing a sparse fringe of short slender bristles.

This attack was first brought to my notice by Mr. George Raymond, of Bloomsfield (King's Co.), N.B., who wrote under date August 1, 1898:—‘A friend of mine in St. John has a small garden, where she has been growing raspberries for a number of years. For the last six years they have been troubled with a worm on the leaves, at first very small, and on the under side. As they grow, they spin a web drawing the leaves all round them and destroying the foliage. They have been much more destructive this year and it is only by persistent picking of the leaves that they can be kept in check.’

Miss H. Raymond, in whose garden the injury was done, wrote a full account covering most of the facts mentioned above, but stating that the larvæ were gregarious, about six being found in the same tent, and from her account and from specimens forwarded to the Division the attack of this species upon raspberries resembles very

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closely that of another *Lyda* which has been found in southern Manitoba upon plum trees (*Lyda rufipes*, Marl.) and was treated of in my report for 1896 at page 253.

Upon rearing the perfect insects, which emerged at Ottawa from the middle to the end of June, specimens were sent to Miss Raymond, and she subsequently wrote saying that she had often seen these flies upon the raspberry bushes about the middle of June. She also stated it was about six years since the insect had appeared in troublesome numbers, and it had been worse during the past four.

Remedies.—As these caterpillars appear on the raspberry bushes at the time the berries are forming, it is inadvisable to use Paris green and similar poisons. Moreover, Paris green has been found to be more injurious to raspberry foliage than to some other plants; if therefore poisons are used, the vegetable poison, white hellebore, is preferable, because, although very fatal to many insects and particularly to all kinds of sawfly larvæ, the poisonous principles, being very soluble, are soon washed away by rain and dew, and there is little danger in using the fruit a week after an application of white hellebore. As, however, the tent-like webs are very conspicuous and this is certainly a very uncommon insect, the method of handpicking which has been successfully adopted by Miss Raymond, will probably in most outbreaks answer all purposes.

THE APIARY.

The following report has been handed in by Mr. John Fixter upon the Apiary, at the Central Experimental Farm, the management of which as heretofore has been left entirely in his hands.

REPORT OF MR. JOHN FIXTER.

THE SEASON OF 1899.

April 1.—Eighteen colonies were removed from the winter quarters: six were placed in the House Apiary, six in the sheltered apiary, and the other six in the exposed apiary. In the case of the two last there was a considerable depth of snow on the ground, from 1 foot to 18 inches. The hives had to be watched as the snow melted to prevent them from toppling over. From April 1 to 4, there was scarcely any flying, but from the 15th to the 17th, there was much more. The hives in the exposed apiary were covered with coarse sacks as a protection, leaving a very small entrance for the bees. In the sheltered apiary and House Apiary no such protection was given. The bees in these apiaries appeared to work better than those which were exposed. On many days when the weather was cool, with cold winds, those that were sheltered were flying well, while none of the others were.

The balance of the colonies were taken from their winter quarters on April 17. All began to fly at once and no mixing appeared to take place. The colonies that were set out early were flying as well as is usual in the month of May. From April 17 to 23, many of the bees were flying every day, when the first pollen was noticed, being brought in off the swamp maples and willows. From April 20 to 30, the bees were seen gathering sap off hard maples that were running, and also off hard maple stumps where trees had been lately cut.

From May 1 to 15 the bees gathered a great amount of pollen, but very little new honey, and nearly every hive was full of brood and young bees—the first drones were noticed May 24. A considerable amount of honey was fed from May 15 to June 1, so as to keep up brood rearing and to prevent starving.

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Up to June 1 there were many flowering trees and shrubs in bloom, but there was no increase in honey. From June 1 to 6, the bees were flying well, gathering pollen, but no increase in honey. On June 6 Alsike Clover came into bloom. Up to June 17 there was no honey gathered. From June 18 to 30, the bees gathered a great deal of honey from clover and raspberry.

On July 3 the first honey was taken off. July 8 the basswood trees were well out in bloom, bees appeared to be very thick on the flowers, but there was very slight increase in weight of hives; during the balance of July, bees gathered very little honey, and there was no increase in the weight of the hives after August 1. The autumn flowers gave no surplus, and there being no buckwheat sown in this district in 1899, no honey was gathered from that source.

The season being such a poor one for honey gathering, all the summer experiments have been left for another season. It is intended to test the different hives with equally strong colonies—Langstroth 8 and 10 frames, Jones hive and Hedden hive—also to test each kind for comb-honey and extracted honey; different-sized sections and further different-sized pieces of foundation in the sections.

HOUSE APIARY.

The House Apiary was again tested with two tiers of hives. This plan can be safely recommended for cities or towns where space is limited, and two tiers can be arranged just as well as one in the same building. This plan can also be highly recommended in sections of the country where the hives are continually being disturbed by boys or in any unused buildings which can be looked up.

RETURNS.

The past season has been a very poor one, both as to the quality and as to the quantity of honey. The returns per hive of the Central Experimental Farm Apiary for the season of 1899 show an average of only eighteen sections per colony. The colonies which were run for extracting gave 23 pounds per colony. Swarming was well kept under, very few colonies being allowed to swarm. The total number of colonies at the end of the season is sixty.

NOTES ON SUMMER MANAGEMENT OF BEES.

There is scarcely a place in Eastern Canada where bees cannot be kept profitably. There are, of course, some localities more favourable than others for the purpose, and there are certain seasons which are so unpropitious that bees have to be fed and little or no surplus honey is stored; but, on the whole, with careful management, bee-keeping may be made not only a remunerative occupation but a source of a great deal of pleasure to those engaged in it.

The keeping of bees may be practised almost anywhere, even in large cities, in towns or villages, as well as on the farm. In cities or towns the hives may be placed on the roof of any building where they get some shade, or, what is better, the hives may be kept inside a room, as explained under the head of House Apiary in previous reports. An important point, however, is to place them where they can be watched carefully during the swarming season.

I would advise placing the hives on their summer stands early in spring without waiting, as is done in many sections, until the soft maples and early willows bloom; but advantage should be taken of the first calm day when the temperature is about 60 degrees. When carrying the bees out, have weighing scales near at hand, also clean bottom boards to replace those which have been in use all the winter, and which must be cleaned before using again. Weigh at once and note the number and weight of each hive, the number for reference, and the weight to know what amount of stores is still left to carry the colony over until the honey flow. On a very warm day when there is no

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wind, examine each colony and see that it has a good laying queen and plenty of stores. Should there be insufficient honey, give them a frame of honey with the cappings scraped off, placing it as close to the brood as possible, also close the entrance more or less according to the strength of the colony. If the colony is very strong, the entrance may be left about two inches in width; if weak, close down to about one-half inch. Great care should be taken to protect the hives from cold draughts in spring. As the weather gets warmer and the colonies stronger, open the entrances. On many days the bees in the House Apiary and in the sheltered apiary will be flying and gathering pollen, while the bees in the exposed apiary are at home keeping the cold air off the brood. If you have a propolis quilt or chaff cushion on the hives, leave it there until the colony is strong enough for a super for sections, or for extracting frames; then all should be removed.

The time for putting on supers is when the hive is full of bees and there are good prospects of a honey flow; by allowing plenty of room, swarming will be prevented to some extent. In this section of the country great care should be taken to see that each colony has plenty of honey during the period between the fruit bloom and clover bloom. Many failures at this time are due to lack of stores, and too much attention cannot be paid to this point. I would advise feeding if necessary up to the clover bloom to force brood-rearing, so as to have the colonies strong. Excessive swarming may be forced or prevented as desired.

If swarms are desired, crowd the bees and stimulate them with syrup. I would not advise allowing more than one swarm from each colony. To prevent excessive swarming give the bees plenty of room and do not wait until they swarm, but put on the supers as soon as the colony is strong enough to work in them. Should swarming occur, remove the hive to another stand, take a new hive, put the swarm into it and place it on the stand from which the swarming hive was removed. The old colony may be further weakened by taking out several frames and shaking all the bees off in front of the newly hived swarm.

For hives placed in a garden choose some convenient place near the dwelling where those busy about the house can see any swarms as soon as they leave the hive and settle. It is better to locate the hives away from the immediate proximity of high trees because when the bees swarm they are apt to settle too high up to be secured without much trouble. When gathering a swarm, a most important help is Manum's wire cloth swarming device, or a similar one, even a large pail attached to the end of a pole, will answer. The use of these will save many swarms and many stings for the operator. The pole may be made in joints so as to allow of extension to the required height. There are many patterns of swarm collectors, most of which consist of a ring of stout wire about 2 feet in diameter, bearing a bag of some light material of about 2 feet in length. This is put up beneath the swarm and the bees shaken into it. It is then lowered and the bees are emptied out in front of a new hive, already prepared for them.

Swarms which settle on shrubs, are much more easily handled. All that is required is to take a piece of sacking, spread it on the ground under the swarm, place the hive properly prepared on the sacking, give the limb or shrub a sharp jar, when the swarm will drop in front of the hive and at once enter it. Another excellent plan is to take a frame of drawn comb or a frame of unsealed brood, and draw it up against the swarm; a large majority of the bees will soon gather upon the frame, which should then be placed in a hive with several more frames. Those bees which have already clustered on the frames will begin to call their companions; as soon as a few have found the entrance they will announce their discovery by the usual vibration of the wings ('humming'). Should the swarm still cling to the tree or shrub, a bunch of grass or a twig from an evergreen is useful to brush them off with. The hive should be left until the bees have all entered it, and as soon as they have done so, the hive should be carried to its permanent location in the apiary. If the colony is a strong one and the season favourable, place at once on the hive a super or extracting frames. When the honey flow and swarming seasons begin, everything should be in readiness to receive the swarms. Supers should be filled with sections, each of which is provided with a full sheet of foundation, and the extracting frames should also have full sheets of foundation in them, and must be

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wired so as to prevent the heavy combs from breaking when the honey is being extracted. Even in the brood frames, full sheets of foundation are preferable, except perhaps for some expert apiarists.

The time to remove section honey is when the supers are fairly well filled and capped; it is best not to wait until the corner sections are filled, as these if not full enough may be put back into the next super. When removing the section honey, start shortly before sundown, smoke the bees at the entrance, then take a wide chisel and gently pry off the super and stand it on end, close to the entrance of the hive; leave it there a short time, then remove it to the honey room, leaving the doors and windows open all night for such bees as still remain on the comb to escape. By the following morning all the bees will have either returned to the hive or gone to the fields. The doors and windows of the honey room should be closed very early the next morning, or robbing will take place. Comb honey should not remain on the hive to be daubed after the sections are sealed. Remove the honey to a very warm dry room, where it will ripen thoroughly. The extracting frames may be left on the hive to ripen until the busy honey season is over; they may be tiered up two or three high. When an empty super is added, put it at the bottom next to the brood chamber. When removing extracting frames, a bee-escape is placed between the extracting super and the brood chamber, and at night the bees will descend through this but cannot return again. When all the bees are down, remove the frames to the extracting room. All honey, whether in comb or extracted, should be kept in a warm, dry room.

JOHN FIXTER.

THE WORST WEEDS OF THE NORTH-WEST.

Strange as it may seem, it is no easy matter to decide off hand what is the *worst weed* in a district, and even in a single locality there is frequently great diversity of opinion on this point. Judging from the replies of correspondents, the 'worst weed in the district' seems to mean the one plant which has given most trouble at a recent date to the farmer who happens to be interrogated.

There are, however, certain plants which, for one reason or another, every year prove to be troublesome and aggressive enemies of the farmer, causing loss of crop, necessitating extra labour, or compelling him to treat or utilize his land in a way other than he would wish.

From a close study of this subject in the West during the past five years and after consultation with the energetic and competent Weed Inspectors of Manitoba and the North-west Territories, Messrs. Charles Braithwaite, of Portage la Prairie, Man., and T. N. Willing, of Regina, N.W.T., respectively, it seems to me that the following plants are specially noxious, and every effort should be put forth to destroy them when detected, or to prevent their introduction to new localities.

STINK WEED or Penny Cress (*Thlaspi arvense*, L.), miscalled sometimes 'French Weed.' Annual. Introduced. A most pernicious and persistent weed with a strong nauseous odour and which endures the lowest temperatures of the West with impunity. Young plants overtaken by winter before their seeds are formed, revive in spring and mature in June; the seeds are produced in enormous numbers, and there are two complete crops ripened every year. This plant belongs to the same natural order as the mustard and cress, the turnip, and the cabbage. The milk of cows which eat it, is tainted and unfit for food. As a field pest it is a vigorous grower, crowding the crop and robbing the land of moisture. The succulent nature of the leaves and stems render it very difficult to kill unless destroyed when quite young.

Remedy.—Plough down before the seed pods form and harrow fallow-land constantly so as to destroy all seedlings. Land for summer-fallowing upon which plants with fully formed pods occur, must be mowed over and the plants burnt before turning down.

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Land under grain crops should be harrowed two or three times with a light harrow having sloping teeth or with a weeder, from the time the grain is two inches high until it is six or even eight inches. Mr. Willing says 'Stink Weed is decidedly the hardest weed we have to handle, and some of it has been found in all districts where farming has been carried on to any extent from Manitoba to the foot hills, and from the United States boundary to the Saskatchewan.'

WILD OAT (*Avena strigosa*, Schreb.).—Annual. Introduced. Closely resembles some varieties of cultivated oats, but ripens its useless hairy seeds irregularly, so that many fall to the ground before the grain they grow among is ripe, thus crowding the crop and infesting the land with a useless and aggressive weed. Mr. Braithwaite says: 'After Stink Weed, the Wild Oat has certainly done farmers the most harm this year.' There are in Canada three kinds of Wild Oats which have been introduced from Europe. The kind most abundant in many parts of the North-west and British Columbia is the Black Wild Oat (*A. strigosa*).

Remedy.—The best means of clearing land of this pest is to work it in early spring and, when many of the seeds have germinated, go over it again with a disc harrow and sow a very early variety of oats or barley, to be cut twice as green feed and then turned down. If this land can be used the following year for a hoed crop or roots it will be better than sowing grain.

CANADA THISTLE (*Cnicus arvensis*, Hoffm.).—Perennial. Introduced. The Canada Thistle, so-called, is extremely abundant in some of the rich lands of the Red River valley and is well established in many spots right across the continent to the Pacific. West of Manitoba, however, it is far less troublesome than many other weeds. Mr. Braithwaite says: 'I may say I am more concerned about Canada Thistle and Tumbling Mustard than any others of our weeds. The Thistle is spreading rapidly from vacant government lands north and east, and the Tumbling Mustard has spread from the North-west down through the Souris districts.' Mr. Willing views its spread in the North-west with anxiety; he says, 'Canada Thistle seems to have come to stay and is very plentiful along the northern branches of the railway, but, it is true, many other weeds as yet are giving more trouble to farmers.'

TUMBLING MUSTARD (*Sisymbrium altissimum*, L.).—Annual. Introduced. This

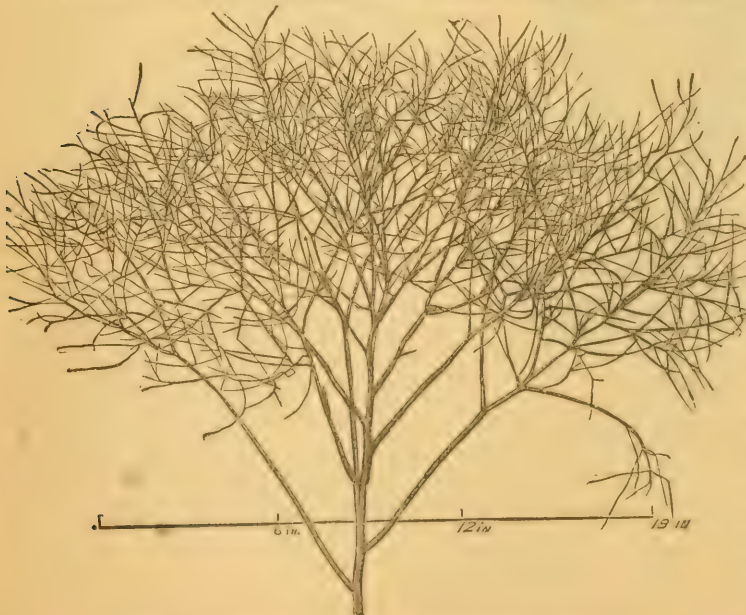


Fig. 16.—Tumbling Mustard: a tumbler with ripe seeds.

coarse member of the Mustard Family was only introduced into the wheat fields of the West about ten years ago, but it has now spread from Indian Head, where it was first noticed, eastward through Manitoba and westward to the interior of British Columbia. Mr. Willing says 'Tumbling Mustard is now more plentiful than any other weed in south-eastern Assiniboia.' Tumbling Mustard has all the bad charac-

teristics of the other mustards and besides is a large free-growing, exceptionally prolific plant, of which when the seeds are ripe the head breaks off and becomes a 'tumbling weed' (Fig. 16), which may be blown for miles across the prairies in the autumn and during the winter, thus scattering the seeds quickly over wide areas. The reddish or greenish-brown seeds are very small, and a single plant produced one million and a half by actual count. Owing to the small size of the seeds, they are easily cleaned from grain. The distribution of the plant is almost entirely by the wind blowing the heads across the prairies during the winter.



Fig. 17.—Hare's-ear Mustard.

Remedy.—The best means of clearing land of this and other kinds of mustard mentioned below consists of harrowing or cultivating with a weeder the growing crops of grain as long as possible in spring, and subsequently hand-pulling the flowering plants and mowing them down at the edges of fields, on road allowances, railway banks and waste places.

HARE'S-EAR MUSTARD [*Conringia orientalis*, (L.) Andrz.].—Annual. Introduced. This is an extremely injurious plant with large leaves, grayish-green, like those of a young cabbage or field pea, but shaped like the ear of a hare or rabbit; flowers small and creamy white, followed by long square pods from 3 to 4 inches long, a vigorous grower and an absorber of much moisture. The ripe stems, sometimes 4 feet high, are wiry and stiff, and give much trouble when grain is harvested, not only in cutting, but also in binding and handling. The seeds of this plant are much larger than those of the Tumbling Mustard and are frequently found in seed grain, with which they are distributed. The Hare's-ear Mustard now occurs widely through Manitoba and the North-west Territories. Mr. Willing places it third in his list of the worst weeds.

FALSE FLAX (*Camelina sativa*, Krantz).—Annual and winter annual. Introduced. A slender-branched plant of the Mustard Family which matures early, the numerous pear-shaped pods containing several seeds. This is widely spread in the West. The chief causes of its increase in the past has been the late date at which summer-fallowing has been done.

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FIG. 18.—Ball Mustard.

BALL MUSTARD [*Neslia paniculata* (L.) Desv.].—Annual Introduced. A tall, slender, somewhat branching, orange-flowered plant, with a great number of small single-seeded almost round pods, each one borne on a slender foot-stalk. Like the Tumbling Mustard and the Hare's-ear Mustard, this is a recent introduction into America, but has spread through the wheat-growing districts with alarming rapidity. Mr. Braithwaite says: 'This is a very bad weed as is shown by the way it has spread.' Mr. Willing writes of it: 'Ball Mustard has made more headway in Alberta and Saskatchewan in a given number of years than any introduced weed.'

WILD MUSTARD (*Brassica sinapistrum*, Bois.).—The true Wild Mustard or Charlock, also called Cadluck and Herrick, is not, compared with many others, a common weed in the West. The plant most frequently spoken of there as Wild Mustard is the Bird Rape (*Brassica campestris*, L.). The two plants may be easily distinguished. In Wild Mustard the stems and leaves are rough, the joints of the stems marked with purple, the knotted pods about one inch long on short thick foot-stalks, erect and tipped with an empty or one-seeded two-edged beak. In the Bird Rape the stems and pods are perfectly smooth and glaucous, the pods, which are from $1\frac{1}{2}$ inches to $2\frac{1}{2}$ inches in length, stand out from the stem on slender spreading foot-stalks.

SHEPHERD'S PURSE (*Capsella Bursa-pastoris*, Moench).—Annual. Introduced. This plant, like the Stink Weed, is frequently overtaken by winter when in full flower, but is in no way injured, the flowers and pods of the late autumn developing the following spring and producing an early crop of seeds. Few people have paid the attention to this weed in the West, which its noxious character, as it there develops, demands, and as a consequence it is increasing and spreading in an alarming manner, not only in gardens but in wheat fields. Owing to the early date

at which the minute seeds develop and the enormous numbers in which these are produced, I fear this weed is going to be a cause of serious loss to western farmers. The plant is easily recognized by its rosette of cut-up leaves lying close to the ground, and bearing from the centre a much branched stem covered from bottom to top with numerous flat triangle-shaped pods. This weed is a close relative of the Stink Weed, and land infested with it should be specially attended to. The seeds are frequently too ripe by the middle of June to allow of their being ploughed down without danger. Summer-fallows should therefore be cultivated or mowed before being ploughed.

LAMB'S QUARTERS (*Chenopodium album*, L.).—Called in different places by several other names, in Manitoba most widely known as Pigweed, also as Fat-hen, Goosefoot and Wild Spinach. Lamb's Quarters, however, is the name used over by far the largest area in Canada, and Pigweed properly belongs to the common Amaranth or Red-root. The Lamb's Quarters, which is an annual plant, of which there are both native and introduced forms, the latter, however, being by far the most abundant in the West, finds in the highly fertile and slightly alkaline soils which prevail there, just such conditions as enable it to develop most luxuriantly, and it is so prevalent in some seasons as to cause a very large loss to farmers, not only in crowding out and robbing the grain while growing, but in every other way reducing the value of the crop by increasing the labour and expense of harvesting, threshing and shipping, and the subsequent and always unpopular dockage for weed seeds by the grain buyer or miller. The Lamb's Quarters prevails to so much greater an extent than any other weed that with some farmers the word 'weeds' means nothing else. It is a succulent annual which does not ripen its

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seeds very early in the season ; therefore, if land is harrowed before sowing and the grain sown in favourable weather, the crop, as a rule, gets well ahead and keeps the lead over the weeds, so that these do not develop to an injurious extent. In springs when there is cold weather after seeding, the seeds of the hardier weeds germinate more quickly than any of the cultivated grains, and in the constant struggle which goes on throughout the season between a crop and its weed enemies, the one which gets the best start, as a rule, holds the advantage to the end. The farmer is able to help much in this struggle to his own advantage, by using improved methods of farming suited to his own land and the variations of the season.

Remedy.—With annual weeds, the main point to be aimed at is to destroy them as seedlings and as soon as possible after the green seed leaves appear. No weed seedling can spring up on land except from a seed, and, if all weeds can be destroyed by any means before they ripen their seeds, the land, in time, must become clean. The method of harrowing growing grain lately practised in the West with excellent results is, I believe, the cheapest and best means of controlling Lamb's Quarters and all other annual weeds which every year do so much harm in western wheat fields, many of which are so large that no other manner of treating them is practicable.

WILD BUCKWHEAT (*Polygonum Convolvulus*, L.).—Annual. Introduced. In certain seasons this climbing bindweed is a terrible pest in the West, many acres of crop being entirely ruined by it. The seeds ripen very irregularly, some of them before the date at which summer-fallows are generally turned down. Western farmers, however, are wisely summer-fallowing much earlier and oftener than has been the custom in the past, and, although in this way they may increase their labour to the extent of one or even two harrowings, there is no doubt that many weeds will noticeably decrease in abundance, this abundance having been largely due to the frequency with which ripe seeds were ploughed down upon land summer-fallowed after the middle of July. Speaking of the last year or two, Mr. Willing says : ' Wild Buckwheat and Lamb's Quarters are getting away with as large a share of the farmer's profit as any of the weeds which occur here.'

Remedy.—The early and regular summer-fallowing of land every third year. Mr. Braithwaite has tried and strongly recommends a method of treating land infested with Wild Buckwheat. He says : ' I have found that, if an ordinary harrow be turned upside down so that the nuts and the tops of the teeth only protrude, a growing crop of grain may be cleaned of most of the Wild Buckwheat by simply dragging the inverted harrows across it. Of course, if a weeder is used at the right time this will never be necessary, but this weed germinates very quickly and roots deeply. When it has about three leaves, it is very tender and the harrows will break off or pull up millions of plants or check them and give the grain a chance.'

RUSSIAN PIGWEED (*Axyris amarantoides*, L.).—Annual. Introduced. This is a tall coarse-growing plant with a hard woody stem which up to the present has not given much trouble in grain fields but is spreading rapidly in Manitoba and the Territories along railways. Farmers will do well to watch it closely and prevent its increase. It belongs to the same family as the Lamb's Quarters.

COW COCKLE (*Saponaria Vaccaria*, L.).—Called also Soapwort, Cow Herb and China Cockle. A soft succulent annual with pretty pink flowers, belonging to the Pink Family, which was introduced into southern Manitoba from Europe. It has spread with rather alarming rapidity through many parts of the prairie provinces. The seeds are round, hard and black, two or three times as large as those of Wild Mustard, the surface is slightly roughened, a character by which they can be easily distinguished from the seeds of wild vetches, which are of about the same size.

GREAT RAGWEED (*Ambrosia trifida*, L.).—Annual. Native. This is the 'Crown-weed' of millers. As an aggressive weed the Great Ragweed seems to be largely con-

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fined to the rich lands of the Red River valley. It is a very coarse tall-growing plant, which does not ripen its seeds until late in the season. Summer-fallowing every third year and a little hand pulling during the two crop years will soon clear land of this weed. The Great Ragweed is particularly obnoxious to grain buyers and millers, owing to the difficulty with which its seeds are separated from grain, as they are of about the same size and weight as the grains of wheat and consequently cannot be easily blown or sifted out of wheat.

CANADA FLEABANE (*Erigeron Canadensis*, L.).—Called also Horseweed and incorrectly 'Fireweed.' Annual. Native. A tall wand-like plant with small greenish-white flowers, to be seen with the two common biennials False Tansy (*Artemisia biennis*, Willd.) and Common Evening Primrose (*Oenothera biennis*, L.) upon all summer-fallows. These three plants all of them flower much later than the time when land should be summer-fallowed to get the best results, both for controlling weeds as well as for the more important reason, in the West, of conserving moisture in the ground. The best remedy then for these is to summer-fallow early.

BLUE BUR (*Echinopspermum Lappula*, Lehm.).—Annual. Introduced. A weed which has appeared only of late years in the West but has spread very rapidly, owing to its bristly barbed seeds. As a rule this weed is a denizen of waste places and roadsides, but it is gradually working its way into the crops. The seeds ripen about the middle of July; therefore land should be ploughed before that date to prevent the plants from seeding.



Fig. 19. Peppergrass

PEPPERGRASS (*Lepidium apetalum*, Willd.).—Native. Winter annual. A weed which occasionally appears very abundantly, particularly on light land and in wet seasons. For the most part the seeds germinate in the autumn and the seeds are produced the following season. The appearance of the plants in autumn and spring is as flat rosettes of narrow deeply indented leaves lying close to the ground with a single central tap root. Disc-harrowing in autumn and spring is the best treatment of land for this and other plants of a biennial habit.

SKUNK-TAIL GRASS (*Hordeum jubatum*, L.).—This grass is one of the most troublesome weeds in hay. Although it may when young be cut as hay and fed without danger, the hard ripe seeds often cause very painful sores in the mouths of horses and cattle, as they are very sharp-pointed and barbed. They run down by the side of the teeth, or penetrate any soft part of the mouth particularly beneath the tongue and into the tongue itself. There are two distinct forms of this grass, one with long silvery awns, 2 inches long, and another with a more erect habit which has awns little more than half that length. Various methods have been tried to clean hay lands of this troublesome pest,

but none with much success. If the Skunk-tail Grass is cut when quite young, it makes tolerably good feed, and hay lands where it occurs should be mowed early before the ripening of this injurious grass. A method of cleaning hay practised at Gladstone, Man., is to toss the hay with a pitch fork on a windy day before using it, when most of the light feathery heads of the Skunk-tail Grass will blow away from the hay and may then be gathered up and destroyed. Whenever this grass is seen in waste places or roadsides it should be mowed before it is ripe and burnt.

This grass is generally described as an annual, but in Manitoba it is certainly a biennial, and apparently sometimes a perennial. It is a bunch grass and has no running root-stocks, growing only from seed.

Native Perennials.

FIG.—20. Indian Hay.

There are a few native perennial plants which are troublesome weeds on farms. Among these may be mentioned the WHITE-STEMMED EVENING PRIMROSE (*Oenothera albicaulis*, Nutt.), the SPREADING DOGBANE (*Apocynum androsaemifolium*, L.), the BLUE LETTUCE (*Lactuca pulchella*, DC.), SKELETON WEED (*Lygodesmia juncea*, Don.), POVERTY WEED, or Smotherweed (*Iva axillaris*, Pursh), the PRAIRIE ROSE (*Rosa Arkansana*, Porter), and INDIAN HAY, or Sweet Grass (*Hierochloa borealis*, R. & S.). All of these on account of the difficulty with which they are eradicated have in different districts been stigmatized as 'the worst weed in the country.' They are all deep-rooting perennials with great tenacity of life, and the method which on the whole has given the best results, is to plough deeply in summer after the plants have drawn off a large amount from their supply of reserve material laid up by the leaves in the underground stems during the preceding summer. The broken up root-stocks, however, will still have much vitality, and if left undisturbed will throw out fresh shoots, and the land will be in a worse condition than before. To prevent this, about a month or less after the first ploughing, the land should be disc-harrowed, and this operation should be repeated again a month later, when the root-stocks of most plants will be so far weakened as to be past recovery. A few, however, as the Canada Thistle, Blue Lettuce and Sweet Grass, may require further treatment and the placing of the land under a hoed crop the next year.

Occasional Weeds.

There are every year, probably dependent on the season, certain plants which, appearing suddenly, draw general attention by their abundance over greater or smaller areas. Some of these are of little importance, but others sometimes cause considerable anxiety and loss. Among these may be mentioned the following:—

WORMSEED MUSTARD (*Erysimum cheiranthoides*, L.).—A biennial plant with acrid principles in all its parts, the seeds particularly having caused death in cattle when fed in quantities among other seeds screened from wheat.

SMALL-FLOWERED WALLFLOWER (*Erysimum parviflorum*, Nutt.).—A native biennial, sometimes abundant in land which has been left without summer-fallowing for too long a period.

WESTERN WALLFLOWER (*Erysimum asperum*, DC.).—Last year one of the most conspicuous plants in some crops in western Manitoba and south-eastern Assiniboia was the beautiful golden-yellow-flowered Western Wallflower, or Prairie Rocket. This is a native biennial very easily pulled from the ground, and, although on account of its brightness it was much noticed, it can hardly be classed as a noxious weed. It very

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seldom grows to a large size in crops and is easily killed by autumn or spring cultivation.

YELLOW WHITLOW-GRASS (*Draba nemorosa*, L., var. *α*, *leiocarpa*, Lindl.).—This is a small few-branched winter annual, seldom more than four to six inches high, with few leaves and a great many smooth pods about half an inch in length on slender wide-spreading foot-stalks. The flowers are bright yellow, borne at the ends of the branches. There is no danger, I believe, of this feeble native plant ever becoming an aggressive crop pest, but it was conspicuously abundant on almost every summer-fallow through Manitoba and the North-west Territories last June. At every one of the twenty-one meetings held, specimens were shown or questions were asked about it.

GRAY TANSY MUSTARD (*Sisymbrium incisum*, Englm., var. *Hartwegianum*, Watson).—Native. Biennial. A tall grayish-green slender plant 3 to 4 feet high, very leafy at the base and bearing at the summit a compressed panicle, thickly loaded with short erect pods. The leaves are very finely divided and cut up, from which fact it is sometimes inaccurately spoken of as 'Rag-weed,' a name which belong to quite a different plant. This crucifer was the most striking unusual plant on western wheat fields and summer-fallows last year, attracting the notice of everybody by its tall cones of grayish green leaves standing up above the young grain in June. Mr. Braithwaite writes: 'The Green and Gray Tansy Mustards were very much in evidence this year, but, being natives and biennials, they only showed up on breaking, summer-fallows, or in crops sown on stubble. Our farmers are now understanding the nature of the different kinds of weeds, and will in future control this kind by late fall or spring cultivation.'

GREEN TANSY MUSTARD (*Sisymbrium incisum*, Englm., var. *filipes*, Gray).—Somewhat like the last, but of a bright yellowish-green colour, and without the hoary pubescence, the branches, instead of being close together, spread loosely and form an open head, the seed pods also are borne on slender spreading foot-stalks, and the leaves are much more finely divided. A character which makes this a more dangerous weed than the last, although as yet it is the rarer of the two, is that the seeds ripen very much earlier, so that there is more danger of the ripe seed being ploughed in when land is summer-fallowed.

GOLDEN FUMITORY (*Corydalis aurea*, Willd.).—An occasional weed in Manitoba is this biennial fumitory. While in the East, where it is rather an uncommon plant on rocky banks, the stems seldom exceed 6 inches in length, in the Manitoban wheat fields patches from 2 to 3 feet across are not uncommon, and instances have been reported to me frequently of several acres of crop being choked out by it.

TARRY COCKLE (*Silene antirrhina*, L.).—A plant which could hardly have been suspected of ever developing into an agricultural pest is the slender-stemmed member of the Pink Family, to which the name of Tarry Cackle has been given. This is a plant with an upright stem bearing (in the West) many erect branches, each joint of which has a dark brown sticky patch to which dust and insects adhere. I have seen this occurring in some quantity at different places, and specimens are frequently sent in by farmers for name. Last summer Mr. Braithwaite found large patches of it in crops at Blythe, south of Brandon, in Manitoba, and the Rev. W. A. Burman saw at least 400 acres near Carberry so infested that the weed had almost crowded out all the wheat.

THREE-FLOWERED NIGHTSHADE (*Solanum triflorum*, L.).—Called also Wild Tomato. A native annual plant with deeply indented leaves, and the whitish flowers in umbel-like, three-flowered cluster, followed by green or purplish berries, about as large as small cherries; the whole plant has a musky odour, pleasant at first but afterwards very nauseous. This weed is a coarse decumbent herb forming patches 2 or 3 feet across, and is frequently troublesome in gardens and around the edges of fields.

SPEAR-LEAVED GOOSEFOOT (*Monolepis chenopodioides*, Moq.).—Annual. Native. A dark green succulent plant forming thick patches wherever soil is a little alkaline. Frequently growing so abundantly in root crops and gardens, as well as in wheat fields, as to require much labour to keep it down. The leaves of this plant are borne very thickly on the clustered stems, the lowest ones shaped like the head of a halberd or spear, but those above becoming gradually simpler in outline and smaller. Short seed-bearing spikes occur along almost the whole length of the stems.

WEEDS AND WEEDERS.

The introduction of weeders into the dry regions of the West, I consider an event of enormous importance to all grain growers. During the past five summers I have had exceptional opportunities, in driving through Manitoba and the North-west Territories, of meeting, and seeing the farms of, some of the best farmers in the West. In many places I have met men who made a practice of harrowing their growing grain crops with a light harrow, and invariably with great advantage. Upon the introduction of the various weeders these were used by a few of the most enterprising settlers, and almost always with decided satisfaction. So much was this the case that last spring several carloads of them were shipped into Manitoba by implement makers. The season of 1899, however, was so wet and late that the weeders were not used so much as would ordinarily have been the case. From what I have seen of these implements here, but particularly at the Indian Head and Brandon Experimental Farms, and from what I know to be the condition of the wheat fields in Manitoba and the North-west Territories with regard to annual weeds, I am convinced that there is more to be hoped for in the regular use of these implements after the grain is up, than from any other measure so far suggested for cleaning lands infested by such aggressive and persistent agricultural pests, as Stink Weed and the different kinds of Mustard, as well as all other seedlings growing among grain crops. Weeders can be used not only safely, but with the greatest advantage to a grain crop, from the time the leaf is an inch high until the plants have shot up 6 or even 8 inches.

One of the frequent complaints made against weeders by western farmers is that they cover too narrow a strip of the crop at a time, but in the *Farmer's Advocate* of Winnipeg for December 5, at page 612, is given a cut, which the proprietors have kindly allowed me to use here, showing a successful way of uniting two of these implements and covering 24 feet at once. In this way the writer, W. F. Baker, of Portage la



Fig. 21.—Two weeders joined.
(Cut kindly lent by the *Farmer's Advocate*.)

weeds are very small, nearly all weeds can be destroyed. On July 18, the wheat thus cultivated was 4 feet high and nicely out in head. The field shown in the cut was 70 acres of the first crop after summer-fallowing. It yielded 1,800 bushels (nearly 26 bushels to an acre), and so far as shipped, graded No. 1 hard. Another 70-acre field, cultivated with the weeder, yielded 29 bushels, while a larger field, that we thought did not require a weeder, yielded only 17 bushels.'

Mr. Angus Mackay, at Indian Head, has the greatest confidence possible in these implements, and last year used them on every acre he had under grain.

Prairie, states that he can go over nearly 50 acres in a day. The two weeders are fastened together with a rope, and the horses are kept apart by a stick between the halters. The wheat in the fields reported upon, had been cultivated twice after it was 4 inches high, and he says, as has been found by many others to be the case, and as I have myself frequently seen: 'If properly used when

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There has been considerable inquiry during the past year or two as to the treatment of grain crops infested with mustard, with solutions of sulphate of iron and sulphate of copper. There is no doubt whatever, as I have proved by experiments here and the Rev. W. A. Burman has shown in Manitoba (1898), that the annual mustards can be killed and even Stink Weed, when young, seriously injured by solutions of sulphate of copper, as weak as $2\frac{1}{2}$ pounds to 10 gallons of water. On this subject I would merely point out that, at the very lowest estimate, and using the most economical effective solution yet recommended (2 per cent sulphate of copper*), \$1 per acre would be the very lowest estimate at which the cost of this operation could be calculated. In the West where a good many of the farmers work several hundred acres, which they frequently never visit again after the spring work is done, until they turn in the reapers at harvest time, this extra expense including the purchase of spraying pumps and sulphate of copper, and the extra work of drawing water, and mixing and applying the solution, would be far less advantageous or likely to be practised, than the use of weeders or light harrows, which most certainly is better farming; for this operation, besides doing better work in destroying the seedlings of all kinds of weeds, has been proved to be most beneficial to the growing crops by reason of the extra cultivation thus given to the land at the very time when it requires it, and the fields so treated yield much heavier crops.

Mr. Charles Braithwaite, who has had greater opportunities of forming an opinion on this matter than any other man in Manitoba, replies as follows to an inquiry as to the utility of surface cultivation of growing grain crops :—

'PORTAGE LA PRAIRIE, Oct. 9, 1899.—I may say that, from my own observations, in ordinary years I certainly agree with your opinion. Working growing grain with light harrows or weeders has a twofold advantage: it destroys weeds and also creates a mulch which prevents moisture from evaporating. Of course, this year being a moist year, the work could not be done as effectually as in drier years. During the season of 1898, Mr. Henry Nichol, of Brandon, had two weeders and kept them going until the grain was 5 and 6 inches high. His crop averaged 30 bushels per acre, while his neighbour's did not average over 15 bushels, and some within 5 miles of him had to plough up their crop on account of weeds and drought. I had this from Mr. Nichol himself, and he is, as you know, a thoroughly reliable man. I could tell you of scores of others who have saved their crops by this method. Of course, as I tell the farmers, this surface cultivation of grain with any kind of implement must be done with common sense, not too deep nor too shallow, and, when the land is in proper condition for harrowing, not too wet and not too dry.'

THE WHEAT CROP IN MANITOBA IN 1899

The wheat crop in Manitoba in 1899 has been estimated at 27,000,000 bushels, almost all of excellent quality and exceptionally free from weed seeds. This satisfactory result is due chiefly to the season. The late date at which severe frosts occurred allowed almost the whole crop to be got in without injury, and the freedom from weeds was due largely to abundant moisture last spring and the previous autumn. On account of cool wet weather last spring, seeding of wheat was much delayed, but the seeds of many weeds being in the ground germinated quickly and came up in the first warm days. Enormous numbers of these seedlings were destroyed at the time the grain was sown; thus the land was clean of all the weeds that had germinated, and the wheat being put in under the most favourable circumstances, germinated promptly and got ahead of the weeds. In addition to the benefit due to the wet spring of 1899, the exceptionally wet autumn of 1898 was also very beneficial by causing many of the seeds of annual weeds to germinate before winter set in, so that they were destroyed by frost. These, under the usual climatic conditions which prevail in ordinary years in Manitoba and the West, do not, for lack of moisture, germinate before the following spring. As a

* See article by Mr. Shutt, page 194.

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consequence of the above mentioned circumstances, the fields were exceptionally clear of weeds last spring, a satisfactory state of affairs which lasted until the end of the season.

The following extracts from letters of men who can speak with authority illustrate this point.

Mr. H. McKellar, who as Chief Clerk of the Department of Agriculture meets farmers from all parts of the province and receives reports throughout the season on the condition of the crops, says as follows :—‘I have made reference on two or three previous occasions to the absence of weed seeds in this year's crop. The fact that the grain is much cleaner this year than it has been for several years is commented upon by everyone who handles grain. In fact, I might say that this year one hears nothing about dockage for weed seeds. This merely bears out the excellent appearance of the fields which we noticed in driving through them together last June and July.’

Mr. Charles Braithwaite, who as Provincial Weed Inspector travels continuously over the province, inspecting crops and advising farmers how best to treat their land and avoid loss from weeds, writes : ‘This is without exception the cleanest crop the West ever reaped. The climatic conditions were favourable ; last summer and fall there was moisture enough to germinate weed seeds, and then again this last spring there was a good growth of weeds before the land was fit to seed. The weeds germinated and were destroyed in the cultivation at seeding time, and the grain came right away.’

The following report is from Mr. G. H. Greig, of the *Farmer's Advocate*, who has good opportunities of judging :—

‘Winnipeg, Oct. 11—The crop generally speaking through Manitoba and the West is very much cleaner and freer of weeds than it has been for some years. The assumption is that, owing to the excessive moisture in the soil last spring, seeding was not started as early as usual, and consequently a great many weed seeds would germinate before any cultivation was given the land ; the seedlings were afterwards killed by the cultivation at seeding time. At all events, the season has not been favourable to weed growth, and crops are cleaner than they have been for years. No doubt, very much credit for this desirable state of affairs is due to the excellent work done by local department of agriculture in holding meetings during the past three years, at which the nature of weeds and the best way to fight them were explained.’

The following report by Mr. F. T. Shutt, Chief Chemist to the Dominion Experimental Farms, will be read with interest by those seeking information as to the remedial treatment of mustard with sulphate of copper and sulphate of iron. The application of these solutions may be found useful in small areas in the East or in British Columbia, but is not a practical nor advisable method to recommend on the large farms in the drier regions of the West.

SPRAYING FOR DESTRUCTION OF MUSTARD.

By FRANK T. SHUTT, M.A., CHEMIST, DOMINION EXPERIMENTAL FARMS.

One of the most persistent weeds that farmers in many parts of Canada have to contend with is mustard, commonly known in Europe as Charlock. Though an annual, it is most difficult to eradicate from fields in which it has become established, owing to the fact that the seed—of which a large number is formed—are endowed with a strong vitality and are preserved from decay by the oil they contain, until favourable conditions for sprouting occur.

Pulling the mustard when it appears among the grain, or keeping the weed from seeding by working the land (as under a hoed crop), are the two methods which have hitherto been in vogue to exterminate this pest, and when the work is done thoroughly they may be considered satisfactory and efficient. The former, however, is always costly, and the latter is sometimes not convenient. When, therefore, it was announced in the agricultural press that spraying with certain solutions of sulphate of iron and

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sulphate of copper had been tried successfully in England and France, it was deemed advisable to make similar experiments here. We should then be in a position to furnish information at first hand on this subject.

The fields of the Experimental Farm being free from this weed, it became necessary to make the trials upon an adjoining farm, and for that purpose a field of barley was selected which showed a considerable amount of mustard. The size of the plot treated in each case was one-tenth of an acre, and the quantity of solution uniformly supplied to each area was 5 gallons, or at the rate of 50 gallons per acre. The date of spraying was June 26, the grain being 15 inches to 20 inches high, and the mustard practically the same height and just coming into flower. The chief data may be briefly stated as follows :—

Sulphate of Iron, 5 per cent.—No effect upon barley. The leaves were practically all stripped from the stems of the mustard, but the weed was not killed, as evidenced by new leaves subsequently starting the plant flowering and the seed-pods filling out and maturing. The leafless stems were quite green a fortnight after the spraying, and were apparently furnishing nourishment to the seed.

Sulphate of Iron, 10 per cent.—A slight scorching of some of the leaves of the barley was to be noticed. A fortnight after the spraying this was not discernible, and, though this spray may have *slightly* retarded growth, it is not probable that the yield of grain was affected.

Though the effect upon the mustard was more pronounced than in the foregoing instance, as noticed by the 'spotting' on the stems, it was not sufficiently strong to prevent flowering and the ripening of the seeds, a large proportion of which proved, upon testing, to be vital.

Sulphate of Copper, 2 per cent.—A certain amount of injury to the leaves of the barley resulted, evidently retarding growth to a somewhat greater degree than the 10 per cent iron sulphate solution. At the end of two weeks, however, this effect had practically all disappeared, and it became doubtful if there were any permanent injury to the grain. The mustard very quickly showed the effect of the spraying, both the stems and the leaves dying without allowing the plant to seed. Two weeks after spraying, a few living mustard plants were found in the plot, but it is believed they had escaped the solution, owing to the height and overshadowing of the barley.

Sulphate of Copper, 5 per cent.—This solution damaged the barley in a much more pronounced manner than the preceding solution ; in all probability it somewhat lessened the yield of grain, though, as the ground was very uneven in character, no comparative data on this point could be obtained.

The mustard was all killed ; an inspection two weeks after the spraying did not reveal any living plants.

In order to ascertain the effect of these solutions upon this weed at a younger stage of growth than that just reported upon, mustard seed was sown in rows in a plot upon the Experimental Farm. When the mustard plants had reached the height of 6 to 9 inches they were sprayed as follows :—

July 20 : *Sulphate of Iron, 5 per cent.*—Not all killed ; the few survivors possessed green stems and in time sent out new leaves. It is extremely doubtful, however, if the plants will have sufficient strength to flower.

Sulphate of Copper, 2 per cent.—All the plants died within a few days.

July 22.—Further sprayings were made : *Sulphate of Iron, 5 per cent.* The stems were stripped of all their leaves, but in the course of a few weeks fresh leaves had appeared on many of the plants. *Sulphate of Iron, 10 per cent.* Though somewhat more severely attacked than by the 5 per cent solution, there was sufficient vigour left in many of the plants to send out new leaves after a few weeks.

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Sulphate of Copper, 2 per cent: Only a very few of the older and more vigorous plants escaped destruction, probably not more than three to five per cent. This solution is evidently strong enough to kill all mustard plants 6 inches in height and less.

Sulphate of Copper, 5 per cent.—All the plants killed.

From the above data, I make the following inferences:—

1. That a two per cent solution of sulphate of copper (that is, 2 pounds in 10 gallons of water) is, all things considered, the most effective, safest (as regards the grain crop) and most economical to use. The spraying should be done thoroughly, and for that purpose 50 gallons per acre will be required. If a heavy rain follows the spraying within 24 hours, the operation will have to be repeated.

2. That, in order that the work may be effective, spraying should not be delayed after the mustard plants have reached a height of 6 to 9 inches. If allowed to grow taller than this, stronger solutions would be necessary and in larger quantity, as the grain would then largely protect the mustard.

NOTES ON LECTURING TOURS IN MANITOBA, THE NORTH-WEST TERRITORIES AND BRITISH COLUMBIA IN 1899.

By instruction of the Honourable Minister of Agriculture and at the request of the several governments of Manitoba, the North-west Territories and British Columbia, I left Ottawa in June last to hold three series of farmers' meetings in the West. The subjects of the addresses delivered were chiefly as follows: In Manitoba, locusts and weeds; in the Territories, weeds and their eradication, special mention being made of the value of summer-fallowing and the use of the implements known as weeders, and nature studies and agricultural education in schools; in British Columbia, the value of Farmers' Institutes, weeds and their eradication, insects injurious to fruits, hay and pasture grasses.

Leaving Ottawa on June 10, I reached Manitoba on the 13th. Passing along the railway between Ottawa and Manitoba, the backwardness of the season was remarkably apparent. Spring flowers which had been in bloom at Ottawa a month earlier, were only now opening their buds. This lateness was also a feature of the season all through Manitoba and the Territories.

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Upon reaching Winnipeg, I made an examination of the shade trees, which are such an attractive feature of this beautiful city, and found that the Ash-leaved Maples were infested by three different insects: (1.) the Negundo Plant-louse (*Chaitophorus negundinis*, Thom.), (2.) the Cankerworm (*Anisopteryx pomataria*, Harr.)—both of these although much less abundant than in former years, still required attention—and, lastly but much more conspicuous, (3.) the Fleshy Leaf-gall of the Negundo. This is a fleshy swelling on the mid ribs of the young leaves which disfigures them very much. The galls are about an inch in length and contain several yellowish larvæ of a small gnat probably belonging to the genus *Diplosis*. An article was prepared for the press under the caption of 'Spray the Trees,' which was published in the local newspapers, and many availed themselves of the advice given therein.

On June 13 I reported myself at the Provincial Department of Agriculture, and, having been joined by Prof. Otto Lugger, the State Entomologist of Minnesota, I left Winnipeg on the 14th, and with Mr. Hugh McKellar, the Chief Clerk of the Provincial Department of Agriculture, who had made arrangements for an investigation of the areas in southern Manitoba, which were infested by the Rocky Mountain Locust in 1898. We reached Boissevain on the evening of the 14th and held a well attended meeting of farmers the same evening. The first



Fig. 22.—The Rocky Mountain Locust.

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address was delivered by Mr. McKellar, who explained what steps had been taken by the Honourable Thomas Greenway with a view to assist the farmers to avoid loss by locusts, which were so abundant in 1898 as to have caused considerable anxiety, and, as none of the observers who had been on the lookout for the egg-laying females last autumn had succeeded in observing any, the hope had been expressed that there would be no locusts this year. The department, however, feared that this was too hopeful a view of the matter, and, on account of the gravity of the case, the Minister had requested the Dominion Entomologist and the State Entomologist of Minnesota to visit the district and examine whether there was any probability of an outbreak of locusts in 1899. Reports had been received that the insects had begun to appear south of Boissevain and Deloraine, and, although the date at that time was three weeks later than when the locusts had appeared last year, it was considered wiser to have the matter investigated carefully, so that, if locusts were found, farmers might be visited and urged to use the methods of destroying the insects which had been found useful elsewhere.

I then followed with a statement of all that was known of the Manitoba occurrences of the Rocky Mountain Locust, the extent of the losses which might accrue if farmers did not adopt the simple and inexpensive means of controlling them which had been advised. Prof. Lugger explained in a lucid manner the life history of this locust, which he illustrated with some large and original charts and gave the results of his long experience in fighting locusts in Minnesota and Dakota. The measures advised were practically those which had already been made known widely through newspapers, agricultural journals and government reports, and were briefly as follows:—The ploughing down in autumn and spring of all stubble in the districts where locusts had been seen, the ploughing down of the young locusts with the stubble as soon as possible after they hatched, beginning at the outsides of fields and working towards the centre; wherever the young had hatched and made considerable growth before the stubble was ploughed down, the use of the hopper-dozers, and on restricted areas the poisoning of the insects with arsenical mixtures.

Mr. Charles Braithwaite, the Provincial Weed Inspector, was also present and spoke at this meeting; he also accompanied us through the rest of our investigation, in which he was of much assistance.



Fig. 23.—Messrs. Fletcher, Lugger and McKellar finding locusts' eggs.

On the morning of the 15th we started early and drove down to the beautiful farm of Mr. A. S. Barton, and thence to Mr. Frank Thompson's, where the exact localities could be pointed out in which the locusts had occurred the previous year. No trace of the insects or their eggs was found; indeed, there was, both here and during a 25-mile drive to Deloraine, a most remarkable absence of all kinds of locusts or 'grasshoppers,' the name by which they are generally spoken of in the West. On reaching Deloraine, we were met by Mr. John Renton, of that place, and Mr. Thompson, of Waskada, who told us that hoppers had been seen on the hatching grounds six miles

south of Deloraine, where I had found them last year. Accordingly, we drove to these farms, where they had been most abundant, and made a thorough search for the eggs. We soon saw that young locusts were hatching in large numbers, some were just emerging from the eggs, and some unhatched; many egg-pods also were empty, but showed that the eggs had been destroyed by parasites. The egg-pods were about an inch below the surface, mostly on elevated spots, and on the sunny side of furrows on these elevated spots. This date of hatching (June 15) was fully three weeks later than that at which the young grasshoppers must have hatched last year, for I found fully matured insects on July 4, 1898. This was due to the late wet spring, a circumstance which also was of great benefit to farmers by making it easier for them to control weeds.

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On the evening of the 15th a meeting was held at Deloraine, which was well attended by farmers from the surrounding country, and addresses were delivered similar to those given at the Boissevain meeting, except that we were now able to speak strongly and definitely as to what steps it was advisable for the farmers to adopt without delay. At this meeting Mr. D. S. McLeod brought specimens of locusts from Lennox, only a few miles south-west of the Deloraine occurrence; these were apparently a week or more older than any we had seen in the fields we visited. At this meeting Prof. Luggar gave the chief address of the evening, describing in detail the best means to adopt under the present conditions to prevent the spread of the swarms now hatching; he also showed plans and explained thoroughly the construction of hopper-dozers, in case these implements should be required later in the season. From what we had seen, however, we were able to encourage the farmers to hope that, if all would plough down the stubbles left for summer-fallowing at once, the locusts might be prevented from spreading and causing serious loss.

After the Deloraine meeting we left for Napinka and took the early morning train to Brandon, where a profitable morning was spent examining the magnificent crops on the Brandon Experimental Farm. The Awnless or Smooth Brome Grass, the introduction of which by the Experimental Farms has been such an immense boon to the farmers of the West, was at that time (June 16) just spearing, and the meadows were a thick mat of grass, over two feet in height. In the afternoon a good opportunity of meeting many of the best farmers of the province was afforded at the ploughing match of the Blythe Farmers' Institute, held near the Brandon Hills Post Office. Here we were again invited to deliver addresses on our grasshopper investigations, a subject which proved of much interest to the hundreds of farmers present. We returned to Brandon in the evening, and on the morning of the 17th I separated from my very pleasant companions.

Owing to the excellent arrangements made by Mr. McKellar and by the generosity of the Northern Pacific and Canadian Pacific Railways who had given the whole party free transportation over their lines, we had been able in a very short time to travel a long distance and also to meet the farmers most keenly interested in the locust occurrences. That the farmers of southern Manitoba appreciated the efforts of the governments to help them, is attested by the following letter received from Mr. McKellar at the end of the season:—

'There is no doubt but that your visits to Manitoba in 1898 and June 1899, examining the Deloraine district, invaded by grasshoppers, did much good. Farmers were interested in the definite information given by you regarding the habits of the grasshoppers and the best methods for fighting them. Instructions *in re* fall ploughing or early spring ploughing and early summer-fallowing have been followed. A few farmers have used hopper-dozers this season, and if necessary, more will be used the coming year. The injury done in 1899 was not appreciable. The crops were of very heavy growth, and the harm done, therefore, not so evident. There has been more fall ploughing in the Deloraine, Whitewater and Boissevain districts last fall than in any previous year. This was partly on account of the very favourable fall, but farmers were no doubt stirred up to the work by the knowledge that they were taking the best means possible for destroying the eggs of grasshoppers that might have been deposited during the summer.'

NORTH-WEST TERRITORIES.

June 18 was spent in answering correspondence which had been forwarded to me from my office at Ottawa, and on the afternoon of the 19th I left for the West, reaching Moosomin at 4 o'clock, in time to join the Honourable G. H. V. Bulyea, the Commissioner of Agriculture for the North-west Territories, and hold an afternoon meeting of farmers; this was the first of a series of seventeen meetings held in the southeast of Assiniboia. These meetings were arranged by the Commissioner to be held at the points where it was considered good work could be done by explaining to farmers living in that magnificent and fertile section: (1) the exact meaning of the North-west Noxious Weed

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Ordinance and the attitude of the Provincial Government on the subject; (2) the nature of noxious weeds, the danger of many varieties being introduced from the East; and giving a detailed description of the kinds most to be feared in each locality, with the best means of eradicating or fighting against them. The order of the meetings was as follows: The Commissioner, who was present at almost every meeting, opened with an exposition of the Weed Ordinance; I followed with a treatment of the subject of weeds and their eradication, illustrating my remarks with fresh specimens of the worst weeds to be found in each locality, either brought in by farmers or collected before the meeting. There were also shown prepared specimens of those not yet introduced but which were to be feared and which might appear at any time among crops. At most of these meetings we were accompanied by, and received much assistance from, Mr. Wm. Trant, of Regina, who not only took an active part in the meetings but prepared careful accounts of each for the press, in which the chief features of the addresses were presented in an excellent manner. Some of these meetings were also rendered much more attractive and useful by the presence and timely addresses of the active Deputy Commissioner of Agriculture, Mr. C. W. Peterson, and the Territorial Weed Inspector, Mr. T. N. Willing, who is both an expert botanist and also a practical farmer who has lived for many years in the West. It will be seen by the list of places given below where meetings were held, that a large area of country was visited, the exceptional fertility of which was clearly proved by the prosperity of the farmers, as evidenced by the fine houses and buildings and the well-kept farms.

At Regina we were honoured by the presence of His Honour the Lieutenant Governor of the North-west Territories, the Honourable A. E. Forget, who took an active part in the proceedings.

The series of meetings began at Moosomin on the 19th and ended at Gainsborough on July 7. They were convened through the different agricultural societies, and in every instance an officer of the local society presided. The enthusiastic welcome accorded the Honourable Commissioner and the keen interest shown in the subject as evinced by the large attendance at all the meetings, and the animated discussions, were very gratifying. The numbers which were present were remarkably large considering the distance most had to travel, and the fact that it was necessary to hold these meetings at a very busy time of the year for farmers.

The following is a complete list of the meetings held, with the name of the chairmen:

Date.	Place.	Chairman.
1899.		
June 19	Moosomin	J. M. L. Young, President, Agricultural Society.
" 20	Whitewood	R. Nicholson, "
" 21	Grenfell	R. D. Lake, M.L.A., "
" 22	Wolseley	Dr. Elliott, M.L.A., "
" 23	Indian Head	Angus Mackay, "
" 24	Qu'Appelle	W. H. Henley, "
" 26	Fort Qu'Appelle	A. Macdonald, "
" 27	Regina	G. Spring-Rice, "
" 28	Moose Jaw	Jno. Battle, "
" 29	Fairmeade	J. Clementson, "
" 30	Glen Adelaide	Wm. Piggott, "
July 1	Clare	J. L. Thompson, "
" 3	Carlyle	Jno. Stewart, "
" 4	Alameda	S. Miller, "
" 5	Oxbow	D. W. Maitland, Secretary, "
" 6	Carnduff	Jno. Young, "
" 7	Gainsborough	Wm. Taylor, President, "

After the Moosomin meeting we went by freight train to Whitewood, arriving there early in the morning of the 20th. The morning was spent in collecting plants

with Mr. T. N. Willing. We took the evening train for Grenfell, where we were met by Mr. R. D. Lake, through whose kindness I was driven out to his home and had an opportunity of seeing the nature of the country and its condition as to the prevalence of weeds. The following morning further opportunities were afforded by a 15-mile drive round by the farm of Mr. T. Skilliter and back to Grenfell, where a very largely attended meeting was held, one of the best of the whole series. After the meeting I returned with Mr. Lake to Col. Lake's house, and the following morning was driven to Wolseley, where we held another good meeting in the new Court House. At Whitewood we were joined by Mr. F. Blakely, of the *Nor'-West Farmer*, who remained with us for all the subsequent meetings but the last. Owing to the much greater altitude, the crops from Moosomin to Grenfell and Wolseley were not nearly so forward as in Manitoba. Winnipeg is about 700 feet above sea level, while Grenfell is nearly 2,000. All crops, however, were in splendid condition and there was every prospect of an enormous yield, the land being, as a rule, clean and well worked.

We reached Indian Head on June 23, when I was met at the station and driven out to the Experimental Farm by Mr. Angus Mackay. During the morning the whole of our party was driven round the farm. Crops of all kinds were in the best of order, and a remarkable object lesson was here seen of the very great value of using harrows and weeders upon growing grain crops. These as a whole were much more advanced than at Grenfell, and those which had been harrowed showed this fact plainly by their greater vigour. The meeting in Indian Head in the afternoon was well attended, and, as was to be expected, summer-fallowing and the surface treatment of growing grain were much discussed. Mr. Mackay has probably taken a more active part than anyone else in the North-west in insisting upon the necessity of a proper system of summer-fallowing for the dry regions of the West, and, as a remarkable confirmation of the accuracy of his views, lands which ten or fifteen years ago were abandoned because it was stated they were too far west and too dry to produce paying crops of wheat, are at the present time selling at a higher price than any other lands in the North-west Territories.

On the morning of the 24th Mr. Mackay kindly drove me himself to Qu'Appelle station and on the way pointed out many features of agricultural interest. The meeting was held in the afternoon, and, like the next one at Fort Qu'Appelle on the following Monday, was particularly well attended, the large number of questions asked and free discussion of the addresses being noticeable features in both places.

On Monday morning June 26, through the kindness of Mr. Donald McKay, I was driven to Fort Qu'Appelle and had a chance to examine many growing crops on the way. This locality was of particular interest because it was from here that the first reports were received of the occurrence as crop pests of the Tumbling Mustard and Hare's-ear Mustard. After the meeting at Fort Qu'Appelle, I drove back to Qu'Appelle Station with Deputy Commissioner of Agriculture Peterson and Mr. Blakely through a torrent of rain and took the train at 20.20 o'clock for Regina.

The following morning was taken up by examining the barracks of the North-west Mounted Police and the successful experiments in cultivating trees and growing flowers which have been carried on for many years by Col. Herchmer. It is very seldom that one can see anywhere such beautiful sweet peas and other annuals, and as well grown vegetables as are produced at Regina in these grounds. A most successful meeting took place in the afternoon at which many prosperous farmers from the surrounding country, as well as several government officials, were present. A vote of thanks to the speakers was proposed by His Honour the Lieutenant Governor, and seconded by Mr. D. J. Goggin, the Superintendent of Education.

The next meeting was at Moose Jaw, and I was much pleased to have an opportunity of driving out both in the morning and in the afternoon to see the grand crops which are now being grown in this semi-arid district, and are due to the recent adoption of the best methods of farming for that section of country. The discussion at the meeting held in the afternoon was mainly upon the treatment of such annual weeds as the various kinds of mustard, several of which were prevalent through the district, the Spear-leaved Goosefoot (*Monolepis chenopodioides*, Moq.) and of such deep-rooted perennials as the White-stemmed Evening Primrose, Poverty Weed (*Iva axillaris*, Pursh),

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known here under the appropriate name of Smother Weed, and the Blue Lettuce (*Lactuca pulchella*, DC.).

Early on the morning of June 29 I left Moose Jaw with Mr. Blakely, and having been joined at Regina by the Hon. Mr. Bulyea, went on to Wapella, where a team was in readiness to take us to Fairmede, 18 miles distant, at which place we held the first of several successful meetings away from the railway, driving from place to place through the country. We were all much surprised at the fine agricultural hall and buildings at Fairmede, but this was soon explained by the prosperity of the farmers in this fertile district. We spent the night at the comfortable home of Mr. John Kidd, who moved out west from the Ottawa district many years ago.

The next meeting was at Glen Adelaide, 22 miles distant, and was reached after a delightful prairie drive in the afternoon. We spent the night at Cannington Manor, and leaving the next morning, were driven by Mr. McDiarmid, M.L.A., through the Moose Mountains and White Bear's Reserve, passing by Heart Hill, one of the highest mounds of these hills, to Arcola (16 miles), where we were hospitably entertained by Mr. J. L. Thompson. Mr. Thompson's farm lies at the foot of the Moose Mountains, with a magnificent stretch of level and extremely fertile land lying to the south of it. The prosperity of this section is clearly shown by the fine houses of the settlers, notwithstanding the long distance over which all produce has to be driven to market or to the railways. In the afternoon Mr. Thompson drove us 7 miles to the new village of Clare, where a meeting was held. A few farms in this district were found to be infested with Stink Weed (*Thlaspi arvense*, L.) and Hare's-ear Mustard [*Courtingia orientalis*, (L.) Andrz.], which had been accidentally introduced a year or two before, but which had been recognized and were being attended to. The Shepherd's Purse (*Capsella Bursa-pastoris*, Moench) and the Green Tansy Mustard (*Sisymbrium incisum*, Engelm., var *filipes*, Gray.) were also remarkably abundant in one or two places, and both plants were seen to be loaded with seeds. At the meeting stress was laid upon the importance of early summer-fallowing and of mowing down all weeds with ripe seeds before the summer-fallows are turned down. We afterwards drove back to Arcola with Mr. Thompson and remained with him until the morning of Monday, July 3.

Leaving at 8 o'clock on July 3, we drove 10 miles to Carlyle, where a large meeting was held in the afternoon, and subsequently 23 miles further to Alameda, on the Souris Branch of the Canadian Pacific Railway, where we were joined by Mr. Trant, and a splendid meeting took place in the afternoon, at which a great number of specimens were brought in by farmers and where there was a most useful discussion. After this meeting we walked to Oxbow, the next station along the railway, passing through the rich lands lying along the Souris River. As we neared the town of Oxbow, we found some crops of wheat in which the Prairie Rocket (*Erysimum asperum*, DC.) was very abundant, and, being such a conspicuous plant, it had naturally caused considerable anxiety among farmers who had recognized it as a member of the Mustard Family. This plant, however, is a biennial which seldom shows itself as abundantly as was the case this year, being a native plant which has never proved to be an aggressive crop pest and which besides is easily pulled up, the large plants never growing very closely together; it is not likely, therefore, to develop into a bad weed.

The meeting at Oxbow was equally successful with the preceding one. The next morning we drove to Carnduff, where we were joined by Mr. T. N. Willing. The farmers here were found to be much interested in the weed question, and the same was the case at the meeting held on July 7 at Gainsborough, many pertinent questions being asked and much interest being taken in the Hon. Mr. Bulyea's efforts to assist the farmers. From Gainsborough a 25-mile drive brought us to Melita on the evening of July 7. Here I finished my work for the North-west Government—three weeks of delightful travelling, in which a large tract of country quite new to me was traversed and in which I had enjoyed many opportunities of studying the insects and plants of the country passed through. I must here express my gratitude to the Hon. Mr. Bulyea for frequent modifications in his plans, which I know were made entirely on my account, so that I might see as much as possible of this interesting country and have every convenience to collect plants and insects, noxious and beneficial.

MANITOBA.

On July 8, in accordance with an agreement with the Manitoba Government, I went to Elkhorn, Man. and addressed a meeting of the Elkhorn Farmers' Institute. I remained at this place till the following day, when I took the train back to Winnipeg to assist in the arrangement of the exhibit of the noxious weeds of Manitoba, shown in the Weed Tent of the Provincial Government of Manitoba at the summer Industrial Fair. This exhibit was an unqualified success. Almost every kind of the noxious weeds of the province was shown, plainly labelled with its English and scientific names, and at all times of the day some officials of the department were in attendance to give such information as might be desired by the thousands of farmers who visited the exhibit every day from early morning till late at night.

BRITISH COLUMBIA.

On the morning of July 13, I left Winnipeg and proceeded westward to British Columbia by way of the Crow's Nest Pass, visiting the thriving and active towns of Nelson and Rossland on the way. I reached Vancouver on July 19, when I joined Mr. J. R. Anderson, the Deputy Minister of Agriculture for British Columbia. The afternoon was spent in admiring the colossal trees and other plants in Stanley Park. On the morning of the 20th New Westminster was visited, and we reached Victoria the same evening. The 21st was spent in the Department of Agriculture, examining the collections and answering correspondence forwarded from Ottawa. In the evening we went out by special train to South Saanich, where a largely attended meeting of the Victoria Farmers' Institute was held; the subjects treated of at this meeting were weeds of the farm and injurious insects. We returned to Victoria the same night, and on the morning of July 22 left for Duncan's, on the Esquimalt and Nanaimo Railway. We were met at the station by Mr. G. H. Hadwen and driven out to his fruit farm. We returned to Duncan's for a meeting of the Farmers' Institute held in the afternoon. The subject of main interest at this meeting was Hay and Pasture Grasses. Noxious Weeds and Agricultural Education were also discussed at some length. After the meeting a visit was paid to the grounds of Mr. W. C. Duncan to examine a patch, which he had had under cultivation for many years, of *Bromus virens*, Buckl. (*B. Hookerianus*, Thurb.), a grass of much promise closely resembling the Southern Brome grass (*Bromus Schraderi*, Kunth). We returned by the evening train to Langford and drove to a meeting of the Metchosin Farmers' Institute. This meeting had been well advertised and was largely attended. After the meeting we drove back to Victoria reaching there at 1.30 a.m.

On Monday morning, July 24, in company with Mr. Anderson, I started for the interior of Vancouver Island; we arrived at Nanaimo about noon and were joined by the Rev. G. W. Taylor, of that place. After lunch we drove 36 miles to Mr. R. F. Hickey's, at French Creek, and later in the evening back to McCarter's Hotel, where an evening meeting was held. This day's journey was full of interest on account of the wonderful forests with which this part of the island is clothed. Objects of great wonder were the enormous trees of *Arbutus Menziesii*, Pursh, many of them over 2 feet in diameter and some large specimens reaching even 3 feet. The next morning we started at 6 o'clock and drove 30 miles to Alberni, arriving there at 3 o'clock in the afternoon.

The drive past Cameron Lake and around the foot of Mount Arrowsmith is one of the most remarkable drives I have ever taken—the road magnificent, smooth and well gravelled the whole way, and through a most wonderful forest, a tract of two miles just past Cameron Lake on the Alberni side, particularly shows the Vancouver Island forests in perfection: gigantic Douglas Spruces, Hemlocks and Cedars—specimens of these trees from 6 to 8 feet in diameter being found by thousands—growing so close together, only 30 or 40 feet apart, that the straight trunks rise up over 100 feet before a branch is reached. The heads of these giants seem very small compared with their towering trunks. The undergrowth beneath these trees is remarkably sparse and consist almost entirely of mosses and ferns, with the beautiful and fragrant *Achlys triphylla*,

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DC. The woods the whole way are characteristically mountain woods. The Salmon Berry (*Rubus spectabilis*, Pursh) with its luscious fruit, like enormous orange or maroon-coloured raspberries, was in full fruit, also the Red-berried *Vaccinium* (*V. parvifolium*, Smith), a most beautiful shrub with bright red fruit like yew-berries, borne singly and produced in such quantities as to bend down the slender branches. A noticeable feature along the road was that many introduced grasses and weeds were abundant which had been brought in either by the road-makers or in carrying hay over the road.

A meeting was held at Alberni in the evening and the following morning we started at 4.30 and drove back 30 miles to Little Qualicum, where we caught the steamer *Thistle* and went to Comox, reaching there at five o'clock in the afternoon. Thence we proceeded at once to Courtney, where we passed the night. The next morning an interesting drive was taken to the mining town of Union and to a beautiful lake three miles beyond. The heat was excessive, but a good meeting was held in the evening, the addresses being followed by animated discussions, the so-called Canada *Thistle* being the principal subject.

On the morning of July 28 we left by the 7.30 steamboat and reached Nanaimo at five o'clock in the afternoon and started at once with the Rev. G. W. Taylor for Cedars, where a small but enthusiastic meeting was held in the evening. We then returned to Nanaimo for the night. A meeting was to have been held at Salt Spring Island on Saturday the 29th, but we found that the steamboat had been taken off for some excursion, and it was impossible for us to reach the island. We therefore returned to Victoria and remained there until Sunday night, when we took the eleven o'clock steamboat for the mainland. Vancouver was reached by eight o'clock and New Westminster at eleven; we then took the steamer for Ladner's Landing, where our first meeting on the mainland had been advertised. Leaving Ladner's at five o'clock the next morning, we drove back and took the steamer opposite New Westminster for Langley. A good meeting was held in the afternoon, after which we proceeded by canoe to Port Haney and from that place walked to Hammond, where we passed the night. The next morning we took train for Abbotsford, where an informal meeting of farmers was held. In the evening we returned to Mission Junction, and the meeting at night was one of the best of this series, being well attended and much interest shown in the subjects discussed. On the morning of August 3, I walked to Hatzic with Mr. Tom Wilson, a member of the Provincial Board of Horticulture, and examined several fine orchards, many of which, however, were seriously injured by the attacks of the Pear Slug, against the injuries of which no steps seemed to have been taken. From Hatzic we proceeded by steamer to Chilliwack, where a most successful meeting took place. Chilliwack is one of the most favoured spots in British Columbia and the meetings, being always well worked up, are invariably satisfactory. On the afternoon of the 3rd we drove out to inspect a currant plantation belonging to Mr. Ford, which was heavily infested by a downy scale insect, *Pulvinaria occidentalis*, Ckll, the western representative form of the well-known eastern Cottony Maple Scale, *Pulvinaria innumerabilis*, Rathvon. Leaving Chilliwack on the morning of the 4th, we reached Agassiz before noon. The afternoon was spent in examining critically the pastures of the Experimental Farm with a view to discover if possible any plants which might be the cause of the disease among cattle known as 'Red Water.' Nothing of importance was discovered, and none of the plants reputed to be the causes of this obscure disease were found in undue abundance, nor could it be seen that any of those which did occur had been eaten by stock which had fed there. A very successful meeting of the Farmers' Institute was held in the evening. This was well attended and was followed by a protracted discussion. In addition to Mr. Anderson and the writer, Mr. Thomas Sharpe delivered an address.

Starting at 4 o'clock on the morning of August 5, an expedition was made to the summit of Mount Ché-am for the purpose of collecting botanical and entomological specimens. We were accompanied by Mr. Allan Brooks, an enthusiastic ornithologist, and one guide, Jim Harris, a Ché-am Indian from Popcum, well acquainted with the mountain and an experienced climber, who was of great service to us. Notwithstanding the lateness of the season and the exceedingly unpropitious state of the weather which prevailed while we were on the mountain, we made large and valuable collections

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both of plants and insects. As a result of the late season, we found on the summit banks of snow 75 and 100 feet deep, where last year at the same date we had seen deep ravines. On the morning of August 8, it began to rain at 6 o'clock, so we decided to descend at once, and at eight o'clock struck camp and began the descent of the mountain in a downpour of rain, which continued all day till we got to the base at 16 o'clock, drenched to the skin, but with all of our specimens safe, as we had wrapped them in waterproof covers before starting. At Popcum we took a hasty meal and crossed the Fraser River by 17.30 o'clock. The following morning was fully taken up attending to our specimens and in drying our clothes to be ready to leave for the upper country on the train at 15.47 o'clock.

We reached Sicamous on Shuswap Lake at 2.35 o'clock and waited there in pouring rain till 6 o'clock, when we took the Okanagan Valley train for Armstrong, arriving there at 9 o'clock. We had hoped to have collected many specimens in this locality, but it rained all day. Our time, however, was by no means wasted, for we examined a very interesting local collection of plants and insects made by Mrs. Walton, of Armstrong, and in the evening held one of the best meetings of our whole trip. This was of the Spallumcheen Farmers' Institute. Some of the worst weeds of the Northwest, including the Tumbling Mustard, False Flax and Ball Mustard, were found to have gained a foothold in this fertile valley, and the farmers were keenly interested in learning all that was to be known about them. The Prickly Lettuce (*Lactuca Scariola*, L.) and the Purslane (*Portulaca oleracea*, L.), both of gigantic dimensions worthy of the Pacific Province, were brought to the meeting. We left Armstrong at 9 o'clock on the morning of August 11, for Okanagan Landing, where we took the fine steamer *Aberdeen* for Kelowna, and reached there at 16 o'clock. After being shown over the new and up-to-date factory of the Kelowna Shipper's Union, where the now well known 'Flor de Kelowna' cigars are made, we were driven out to see the surrounding country by Mr. J. T. Davies, the President of the Okanagan Farmers' Institute. We first visited Lord Aberdeen's ranche at Guisachan, where we were shown fields of Smooth Brome grass. We then visited the extensive and successful tobacco plantations of Messrs. Collins and Holman, and finally accompanied Mr. Davies to his own home. The meeting at Kelowna was held at 20 o'clock in the evening and was, as is always the case at this bright active little town, well attended and very successful. We left this delightful place at noon on August 12 and reached Enderby at 18 o'clock the same evening; there we left the train and drove across the country to Salmon Arm, arriving at 20.30 o'clock, just in time for the meeting of the Salmon Arm Farmers' Institute. This meeting, although not so largely attended as those at Armstrong and Kelowna, was full of interest, as this place is becoming a fruit growing centre of importance in the province. The addresses were attentively listened to and fully discussed.

This was the last of a series of sixteen useful and most enjoyable meetings held with Mr. Anderson in the best agricultural and fruit growing districts of British Columbia. Mr. Anderson's thorough knowledge, not only of the capabilities of his province, but also of its fauna and natural history, made him a most entertaining companion; the careful arrangements he had made beforehand enabled me to take the fullest advantage of the expedition, which was of inestimable value to me in becoming acquainted with the conditions prevailing in the various localities visited, so that I might be of as much use as possible in the future to such farmers of British Columbia as may wish to correspond with the Division of Entomology and Botany.

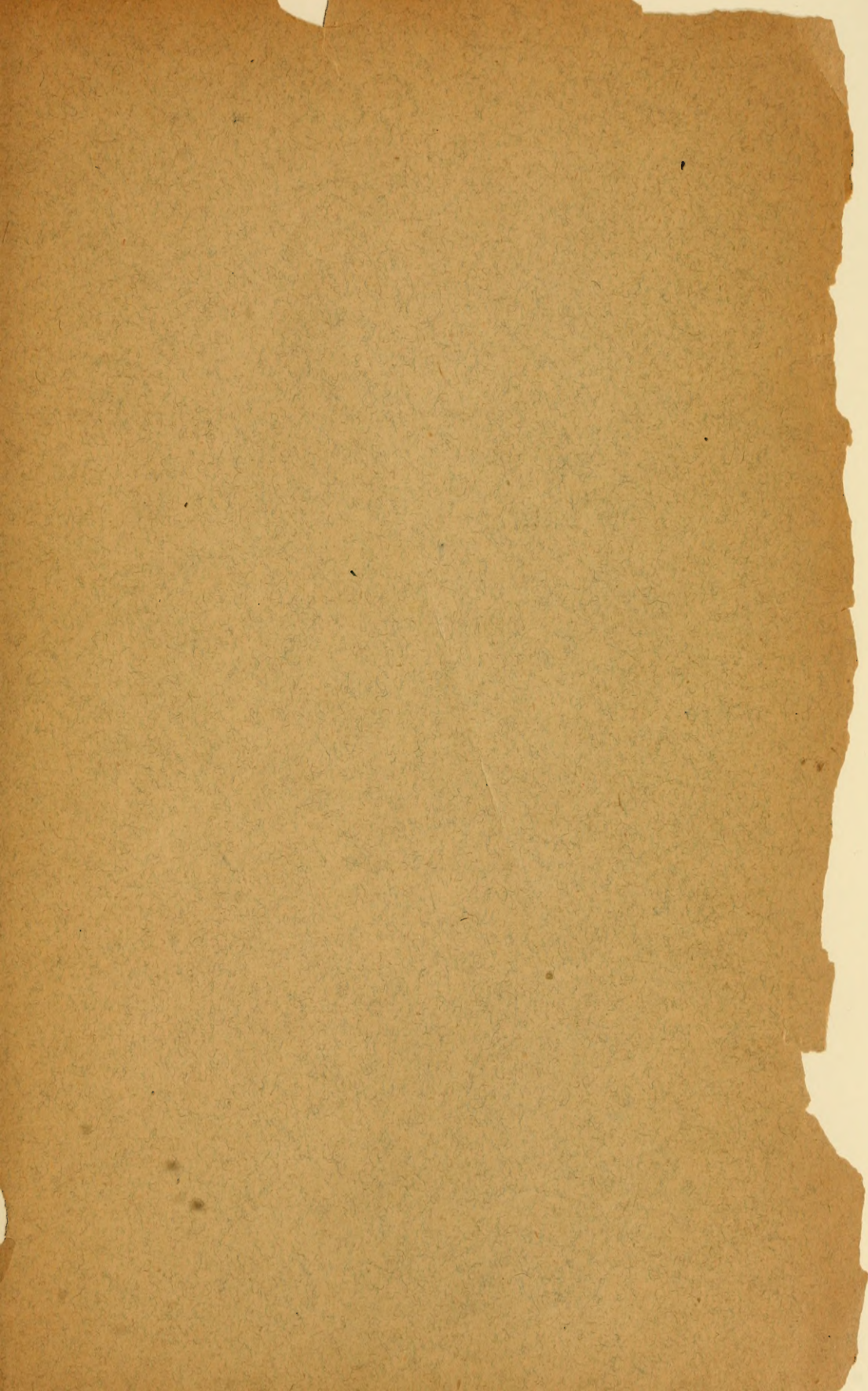
We left Salmon Arm at 1.25 o'clock and reached Banff, Alta., by 17 o'clock on August 13. I remained there until the next day, when in company with Mr. W. C. McCalla of St. Catherine's and Mr. N. B. Sanson, Curator of the Government Museum at Banff, both enthusiastic botanists we sallied out, and, notwithstanding the torrents of rain which fell almost continuously, I added several desirable botanical specimens to my collections. On August 14, I left for home at 16.10 o'clock, reaching Winnipeg at 21 o'clock on the 15th, and Ottawa at 18 o'clock on August 17.

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